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Experiments on the Friction and Abrasion of the Surfaces of Solids.

By George Rennie, Esq. F. R. S.

From the Transactions of the Royal Society.

Continued from page 12.

Table IX.—*Experiments on the Friction of Axles without and with Unguents.*

Wt. on axle.	Weight required to move it.	Time.	Proportion.	Space passed over.
Gun Metal on Cast Iron.				
cwt.	lbs. oz.	sec.		
1	16 0	90	7.00	
2	30 0	...	7.46	
3	44 0	...	7.63	
4	60 12	...	7.37	
5	112 0	80	5.00	
6	134 0	90	5.01	4½ inches.
7	After remaining 12 hours it took to move it. 154 0	...	5.09	
8	175 0	...	5.12	
9	200 0	...	5.04	
10	238 0	...	4.70	

Experiments on the Friction of Axles without and with Unguents.

Wt. on axle.	Weight required to move it.	Time.	Proportion.	Space passed over.
Yellow Brass on Cast Iron.				
cwt. 10	lbs. oz. 272 0	sec. 90	4.11	4½ inches.
Cast Iron on Cast Iron.				
cwt. 10	lbs. oz. 173 8	sec.	6.45	
11	228 0	90	5.40	4½ inches.
Cast Iron on Cast Iron with Black Lead.				
cwt. 11	lbs. oz. 161 0	sec. 90	7.65	4½ inches.
Gun Metal on Cast Iron with Black Lead.				
cwt. 11	lbs. oz. 170 0	sec. 90	7.24	4½ inches.
Yellow Brass on Cast Iron with Black Lead.				
cwt. 1	lbs. oz. 14 12	sec.	7.59	
2	31 4		7.16	
3	47 8		7.07	4½ inches.
4	65 8	90	6.83	
5	84 0		6.66	
11	181 0		6.80	
Gun Metal on Cast Iron with Oil.				
cwt. 11	lbs. oz. 218 8	sec. 90	5.63	4½ inches.

Experiments on the Friction of Axles without and with Unguents.

Wt. on axle.	Weight required to move it.	Time.	Proportion.	Space passed over.
Yellow Brass on Cast Iron.				
cwt.	lbs. oz.	sec.		
$\frac{1}{2}$	1 8		37.33	
1	3 8		32.00	
2	7 0		32.00	
3	16 8		20.36	$4\frac{1}{2}$ inches.
4	24 8	90	18.28	
5	29 4		19.14	
10	193 8		5.78	
11	200 12		6.13	
Cast Iron on Cast Iron.				
cwt.	lbs. oz.	sec.		
10	131 1	90	8.54	$4\frac{1}{2}$ inches.
11	140 0		8.80	
Cast Iron on Cast Iron with Hogs-lard.				
cwt.	lbs. oz.	sec.		
10	117 4	90	9.55	$4\frac{1}{2}$ inches.
Yellow Brass on Cast Iron.				
cwt.	lbs. oz.	sec.		
$\frac{1}{2}$	1 10		34.46	
1	3 1		36.57	
2	7 8		29.86	$4\frac{1}{2}$ inches.
3	23 0	90	14.60	
4	43 0		10.41	
5	47 8		11.78	
10	120 8		9.29	
Gun Metal on Cast Iron with Hogs-lard.				
cwt.	lbs. oz.	sec.		
10	130 4	90	8.59	$4\frac{1}{2}$ inches.

Experiments on the Friction of Axles without and with Unguents.

Wt. on axle.	Weight required to move it.	Time.	Proportion.	Space passed over.
Yel. Brass on Cast Iron with Anti-attrition Composition.				
cwt.	lbs. oz.	sec.		
1	7 8		14.93	
2	9 0		24.88	
3	10 8		32.00	
4	12 8		35.84	
5	14 8	90	38.62	4½ inches.
after remaining 41 hours in a state of rest with 10	it took 190 0		5.89	
fresh composition being applied 10	it took only 23 8		47.65	
10	again 20 0		56.00	
Yellow Brass on Cast Iron with Tallow.				
cwt.	lbs. oz.	sec.		
1	3 1		36.57	
2	5 12		38.95	
3	8 5	90	40.42	4½ inches.
4	11 1		40.49	
5	13 12		40.72	
Yellow Brass on Cast Iron with Soft Soap.				
cwt.	lbs. oz.	sec.		
½	2 2		26.35	
1	3 8		32.00	
2	6 0		37.33	4½ inches.
3	9 8	90	35.36	
4	12 12		35.13	
5	14 12		37.96	
Yellow Brass on Cast Iron with soft Soap and Black Lead.				
cwt.	lbs. oz.	sec.		
½	5 8		10.18	
1	9 3		12.19	
2	12 1		18.56	4½ inches.
3	14 4	90	23.57	
4	19 8		22.97	
5	23 8		23.82	

Remarks on the Experiments without Unguents.

From the foregoing experiments it appears—

That when gun metal without unguents is loaded with variable weights of from 1 to 10 cwt., friction varies nearly in the proportion of $_{7}.\frac{1}{13}$ to $_{2}.\frac{1}{75}$ of the pressure.

That length of time scarcely affects it.

That friction increased when yellow brass was tried.

That friction decreased when cast iron was tried.

That friction diminished still more when black lead was used between the three different metals.

Remarks on the Experiments with Unguents.

That gun metal on cast iron, with oil intervening and a weight of 10 cwt. amounted to $_{2}.\frac{1}{83}$ of the pressure.

That when the insistent weights were diminished, the friction with oil was reduced to $_{37}.\frac{1}{33}$, but increased with an increase of weight.

That cast iron on cast iron, under similar circumstances, showed less friction.

That the friction of cast iron on cast iron was still further diminished by hogs-lard.

That the friction of yellow brass on cast iron was increased by light weights and diminished by heavy weights, perhaps from being less fluid and sensible in the one case, and more capable of preventing the contact of metals in the other.

That gun metal on cast iron with hogs-lard gave less friction than with oil.

That yellow brass on cast iron with anti-attrition composition of black lead and hogs-lard, increased friction with light weights, and greatly diminished it with heavy weights, showing extremely irregular results.

That yellow brass on cast-iron with tallow gave the least friction, and may, therefore, be considered the best substance under the circumstances tried.

That yellow brass on cast iron with soft soap gave the second best result, being superior to oil.

That yellow brass on cast iron with soft soap and black lead gave the worst result, diminishing the friction in the inverse ratio of the weight.

Conclusion.—That the diminution of friction by unguents, varies as the insistent weights and natures of the unguents; the lighter the weight the finer and more fluid should be the unguents, and vice versa.

TABLE X.—*Experiments on Velocities in Friction.*

A cast iron Cylinder with two bearings of one inch wide, six inches diameter, with two side collars one-eighth of an inch deep; a rope of three-eighths of an inch diameter wound round the cylinder. Bearing surface 12½ square inches. (See Fig. 1 and 2, page 2.)

Without Oil.

Weight in roller scale.		Wt. required to move the roller.		Height fallen.	Time in falling.	Remarks.	Proportion.
lbs.	oz.	lbs.	oz.		Seconds.		
348	8	112	0			Four trial experiments made by decreasing weight; very unsteady motion.	3.11
300	0	112	0		5		2.67
280	0	114	0		7*	* Began to grind.	2.45
280	0	114	0		7†	† Grinding increasing with stopping.	2.45
280	0	228	0		4½		1.22
224	8	112	0		6		2.00
224	8	112	0		4½		2.00
174	8	58	0		4		3.00
174	8	58	0		4		3.00
174	8	116	0	21	2		1.50
174	8	116	0	feet.	2		1.50
160	8	56	0		7		2.86
160	8	56	0		8		2.86
66	8	28	0		8		2.37
62	8	22	0		4		2.84
62	8	22	0		4		2.84
62	8	44	0		2½		1.42
62	8	44	0		2½		1.42
62	8	44	0		2½		1.42

Experiments on the Velocities in Friction.

Experiments with Oil.

Weight in roller scale.		Wt. required to move the roller.		Height fallen.	Time in falling.		Remarks.	Proportion.
					1st half.	2d half.		
lbs.	oz.	lbs.	oz.		Seconds.			
62	8	7	0		12			8.92
62	8	7	0		17½			8.92
62	8	7	0		11	22		8.92
62	8	7	0		9	18		8.92
62	8	7	0		8	16		8.92
62	8	7	0		8	16		8.92
62	8	7	0	21	8½	17		8.92
62	8	14	0	feet.	3	5	Found the velocity too great; made an addition of 21½ lbs. making ¾ cwt. in the fixed scale, which brought it regular.	4.46
62	8	14	0		3	5		4.46
62	8	14	0		3	5		4.46
84	0	14	0		3½	7	This weight produced a regular velocity.	6.00
84	0	14	0		3½	7		6.00
84	0	14	0		3½	7		6.00

Experiments with Tallow.

lbs.	oz.	lbs.	oz.		Seconds.			
272	8	42	0		14	28		6.48
272	8	42	0	21	6½	13		6.48
272	8	42	0	feet.	6½	13		6.48
272	8	42	0		7½	14		6.48

Remarks.

The irregularity of the resistances observed in the first seven experiments arose from the partial contact and consequent grinding or abrading of the surfaces. The roller having attained its bearing, and the weight in the roller-scale being diminished, the irregularity ceased, especially when oil and tallow were used.

From the result of these experiments it will be seen, that friction did not increase with an increase of velocity. The time in falling the whole height of twenty-one feet being double the time in falling half the height. These experiments were likewise illustrated (but not so satisfactorily,) by a machine somewhat similar to that of Mr. Roberts'.—The pulley was sufficiently distant from the roller to render the angle of tension imperceptible.

Appendix to TABLE X.

Friction of the cord and weight on the axles of the iron rollers, to be deducted from the foregoing experiments.

Weight in each end.	Total of weights.	Weight required to overcome the friction of the cord.
lbs.	lbs.	lbs. oz.
56	112	4 8
112	224	7 0
168	336	11 4
224	448	14 0

Remarks on TABLE X.

The deductions to be made for the rigidity of the cord used in the foregoing experiments under variable weights, as shown in the second and third columns, are nearly as the weights simply, and are applicable to most of the cases in Table IX.

TABLE XI.—*Experiments on the Friction of Ice.*

A block of ice eighteen inches long and two inches thick, as free as possible from air-bubbles, was accurately prepared so as to present a smooth, flat surface, and was then fixed on the frame. A piece of the same block of ice, but of smaller dimensions, was accurately prepared, and made to glide with its flat surface over the bottom block, and a fine flexible silken cord attached to it as in the former experiments.

The weights in the first column indicate the insistent weights, and the weight in the second column the moveable weights. The experiments were made when the temperature of the atmosphere was about 28 degrees of Fahr.

Weight on surface.	Weight required to move it.	Proportion.
Sixteen inches surface.		
lbs. oz.	lbs. oz.	
1 8	0 3	8.00
4 0	0 5	12.80
16 0	0 10	25.60
36 0	1 0	36.00
64 0	1 6	46.54
81 0	1 13	44.68
144 0	2 9	56.19

Experiments on the Friction of Ice.

Weight on surface.	Weight required to move it.	Proportion.
After remaining 16 hours.		
lbs. oz.	lbs. oz.	
1 8	0 3	8.00
4 0	0 6	10.66
16 0	0 15	17.06
36 0	1 9	23.04
64 0	3 2	20.48
81 0	4 0	20.25
144 0	6 5	22.81
With two skates $4\frac{1}{2}$ inches long, by $\frac{3}{16}$ wide, in surface in each.		
lbs. oz.	lbs. oz.	
1 8	0 1	24.00
4 0	0 3	21.33
16 0	0 7	36.57
36 0	0 15	38.40
64 0	1 2	56.88
81 0	1 10	49.84
144 0	2 1	69.81

Remarks.

From the foregoing experiments it appears, that with ice on ice, friction diminishes with an increase of weight, but does not seem to observe any regular law with regard to that increase.

TABLE XII.—*Experiments on the Friction of Hide Leather.*

Twelve pieces of hide leather were placed parallel to each other in a wooden box, with one side loose so as to admit of being adjusted according to the number of pieces of leather; a bolt was then passed through the whole, and a nut screwed on the end of the bolt so as to compress the pieces of leather together and permit them to act on edge as one uniform surface; which surface was increased or diminished by putting in or taking out some of the pieces of leather and screwing up the nut as before.

Friction of 9 square inches of Leather soaked in water, moving over a plate of Iron.

7 lbs. barely kept in motion 36 lbs. after starting with the hand. After remaining 5 minutes it took 29 lbs. to start it. 28 lbs. barely

kept in motion 64 lbs. after starting it, and after remaining one minute it took 42 lbs. to start it.

Surface $1\frac{1}{2}$ *by* 3 *inches, equal to* $4\frac{1}{2}$ *inches area.*

$6\frac{1}{2}$ lbs. barely kept in motion 36 lbs. after starting it. After remaining 5 minutes it took 21 lbs. to start it. 21 lbs. barely kept in motion 64 lbs. after starting it. After remaining 5 minutes it took 38 lbs. to start it.

Friction of Hide Leather moving dry over a surface of Cast Iron.

Weight on surface.	Wt. required to move it.	Proportion.	Space passed over	Time.	Weight per inch of area.
Area of surface 9 square inches.					
lbs.	lbs. oz.		inches.	sec.	lbs.
6	1 8	4.0			.66
7	1 12	4.0			.77
8	2 0	4.0	18	18	.88
36	8 12	4.1			4.00
49	12 0	4.0			5.44
64	16 0	4.0			7.11
Area of surface $6\frac{3}{4}$ square inches.					
lbs.	lbs. oz.		inches.	sec.	lbs.
6	1 4	4.80			.88
7	1 8	4.66			1.03
8	1 12	4.57	18	18	1.18
36	7 4	4.96			5.33
49	11 0	4.45			7.25
64	14 0	4.57			9.48
Area of surface $4\frac{1}{2}$ square inches.					
lbs.	lbs. oz.		inches.	sec.	lbs.
6	1 2	5.33			1.33
7	1 5	5.33			1.55
8	1 9	5.12	18	18	1.77
36	7 3	5.00			8.00
49	9 5	5.26			10.88
64	13 10	4.69			14.22

Friction of Hide Leather moving dry over a surface of Cast Iron.

Weight on surface.	Wt. required to move it.	Proportion.	Space passed over	Time.	Weight per inch of area.
Area of surface 2¼ square inches.					
lbs.	lbs. oz.		inches.	sec.	lbs.
6	1 1	5.64			2.66
7	1 3	5.89			3.11
8	1 8	5.33	18	18	3.55
36	7 1	5.09			16.00
49	9 1	5.40			21.77
64	13 2	4.87			28.44

Remarks.

The friction of hide leather soaked in water appears to be greatly increased by time and weight. This circumstance explains the enormous friction evinced in the pistons of pumps when first put in motion. When the leather is not soaked, the resistance varies from one ⅓th to nearly one ⅛th of the pressure, and is diminished (cæteris paribus) by a diminution of surface.

TABLE XIII.—*On the Friction of Stones.*

Rondelet found that stones, well dressed, required angles of from 28° to 36° before they commenced gliding.* Perronet observed them to vary from 39° to 40°.† The granite voussoirs of the arches of the New London Bridge having their beds well faced and dressed without mortar, generally commence gliding at angles of from 33° to 34°. But with a bed of fresh and finely ground mortar interposed, the pressure on the centring commences at angles of from 25° to 26°. In other cases of arches where sand stones, such as Bramley Fall and Whitby, were employed, and their beds faced and dressed as usual, the angle of gliding was found to vary from 35° to 36°. But with mortar interposed the angle generally varied from 33° to 34°.

It results from these and other experiments, that friction, by absorbing part of the horizontal thrust, is a most powerful assistant in maintaining the equilibrium of arches, and enables us to determine with something like precision the allowances due to theory.

In general, stones which have a fine grain and uniform texture, and are sonorous and heavy, resist abrasion in proportion to their hardness; and in some experiments of Morisot,‡ granite resists abra-

* L'Art de Batir. Tome iii.
† Mémoire sur le Cintrement et Décintrement des Ponts.
‡ Morisot. Tome iv.

sion twelve times more than lias, whilst the former only possesses a repulsive power three times greater than the latter.

The experiments of Boistard give 0.78 for the friction of hard calcareous stones.*

TABLE XIV.—*On the Friction of Machines.*

1. 21 cwt. suspended at each extremity of a chain (passing over two cast iron sheaves of 2 feet diameter with wrought iron axles, working in brass bearings oiled, and 12 feet 10 inches apart) was disturbed by 3 cwt. or $\frac{1}{14}$ of the total weight. Another double purchased crane indicated $\frac{1}{9}$th.

2. A double purchased crane having a weight of 7057 lbs. suspended to it indicated 7.62 for the friction. Another double purchased crane indicated $\frac{1}{3}$th.

In an experiment made on one of the corn mills recently erected for His Majesty's victualling department at Deptford, it required $\frac{1}{70}$ of the weight of the mass to overcome the inertia and friction of the bearings and tangential surfaces. In this instance the pressures of the different parts of the machine varied from 28 lbs. to 8 cwt. per inch area, and the velocities of the surfaces from 50 feet to 120 feet per minute.

Remarks.

It has been customary to deduct one-fourth of the power expended for friction. This allowance may obtain in machines newly set in motion. When the bearings have been equalized and the rubbing surfaces extended by the abrasion of the irregularites, the friction will be diminished and the movements of the machine be more steady. But when the bearings are properly proportioned to the weight of the parts of the machine, and their surfaces kept from contact by unguents, a much less allowance may be made.

Several experiments were made by giving motion to a fly wheel and a grind-stone of known weights and revolutions in a given time, and then counting the revolutions after being detached from the power; but owing to the resistance of the air, and the bearings being too small, the results were unsatisfactory.

TABLE XV.—*Showing the amount of Friction (without Unguents) of different Substances, the insistent Weight being 36lbs. and within the limits of Abrasion of the softest substance.*

	Parts of the whole weight.
Steel on ice	69.81
Ice on ice	36.00
Hard wood on hard wood	7.73

* Recueil d'Experiences et d'Observations, &c.

	Parts of the whole weight.
Brass on wrought iron	7.38
Brass on cast iron	7.11
Brass on steel	7.20
Soft steel on soft steel	6.85
Cast iron on steel	6.62
Wrought iron on wrought iron	6.26
Cast iron on cast iron	6.12
Hard brass on cast iron	6.00
Cast iron on wrought iron	5.87
Brass on brass	5.70
Tin on cast iron	5.59
Tin on wrought iron	5.53
Soft steel on wrought iron	5.28
Leather on iron	4.00
Tin on tin	3.78
Granite on granite	3.30
Yellow deal on yellow deal	2.88
Sand-stone on sand-stone	2.75
Woollen cloth on woollen cloth	2.30

These results are collected from the different Tables, but the comparison may be made by selecting other values within the limits of abrasion for a minimum.

General Conclusions.

From what has been stated hitherto, it is obvious,—

1st. That the laws which govern the retardation of bodies gliding over each other are as the nature of those bodies.

2nd. That with fibrous substances, such as cloth, &c. friction is increased by surface and time, and diminished by pressure and velocity.

3d. That with harder substances, such as woods, metals, and stones, and within the limits of abrasion, the amount of friction is as the pressure directly, without regard to surface, time, or velocity.

4th. That with dissimilar substances gliding against each other, the measure of friction will be determined by the limit of abrasion of the softer substance.

5th. That friction is greatest with soft, and least with hard substances.

6th. That the diminution of friction by unguents is as the nature of the unguents, without reference to the substances moving over them.

The very soft woods, stones, and metals, approximate to the laws which govern the fibrous substances.

In comparing the present experiments with those of Coulomb, the discordances found to exist relate principally to time. The limited pressures varying from 1 to 45 lbs. per square inch, under which his

experiments were made, account in some degree for the anomaly. But in many of the minor, and in the general results, they will be found to coincide.

The subject might be illustrated still further, by detailing the results of other experiments on the motions of machines, on the friction of solids revolving in fluids, and the descent of carriages down inclined planes. But as the present inquiry principally relates to the friction of attrition of solids, and as the experiments last mentioned have not been sufficiently matured to arrive at the necessary deductions, it only remains to conclude by expressing a hope, that the data now furnished will in some degree enlarge the bounds of our knowledge on this subject; interesting as one of philosophical inquiry, and intimately connected with every branch of the mechanical arts.

On the Substitution of Plumbago for Oil, in Chronometers. *By* Mr. L. Herbert.*

Sir,—Permit me to offer you a few observations upon a subject, which fifteen years of experience have produced; namely, the substitution of plumbago for oil in the rubbing parts of chronometers, in order that they may be laid before the Society of Arts; and thus, if approved, become beneficial to the world at large.

The use of sidereal and mean time pieces in observatories at sea or on land, is to measure the motions of the heavenly bodies, and by them ascertain their right ascension in time, their distance from a given point, and to obtain the longitude of places upon the earth. From that, the word *chronometer* (measurer of time) is derived; but very few deserve that appellation. Whatever may have been the skill of the maker, and the care he took for their perfect construction, the observer must not expect to find them infallible; and however well regulated they were at first, they will not remain so, permanently. Their rate of going will be accelerated or retarded by the temperature of the atmosphere, which causes all metals to expand or contract, more or less, and that in an irregular degree; this will create a variation in their movements; and though innumerable experiments have been tried to render them perfect chronometers, by compensating pendulums or balances that might contravene the atmospheric influence, yet none have been found that would accomplish that desideratum; because it is evidently proved, that metals, after having been acted upon several times by heat and cold, never return to their primitive state at the same temperature.

But, sir, this is not the only difficulty chronometer makers have to combat against; there is another powerful enemy which is always baffling their success, that is, *oil*. The different degrees in the fluidity

* From Vol. XLVI. of the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. The Society voted its gold medal to Mr. Herbert for this discovery.

of that liquid, are also great alterants of clock movements. In hot climates it will become absorbed, in cold weather it will congeal, and in both instances impede the freedom of motion. This, nevertheless, may be remedied by a substitute, which I discovered about fifteen years ago; and in order to befriend science, I will here name it, and explain the way of applying it to time-pieces, for the benefit of those who do not mind a little trouble, and have patience enough to go through the process it requires. It is *plumbago;* which, when carefully used, will last a considerable time, without the necessity of being renovated. But much depends upon its quality. It must be of the best kind, free from grit, and the tenderer the better. A spurious sort would endanger the holes and pivots, causing mischief instead of preventing it. The purest I could procure was from the late Mr. Langdon, who was the first pencil-maker in London (perhaps in the world,) Great Russel Street, Bloomsbury; who, after I had explained to him the purpose it was intended for, considered its choice of the utmost importance, and selected some of the best, which answered my utmost expectation. I applied it to my sidereal time-piece, in January, 1816. Since that time, *it has been cleaned three times, without the plumbago being renovated.* The friction places were only wiped over with a fine piece of muslin; and now, in 1827, it goes as well as ever!

I must beg to observe here, that I then found an insurmountable difficulty in charging the jewelled pallets of the escapement with the plumbago; but I obviated that, by applying it to the friction-planes of the teeth of the swing-wheel; and so, ever since, the clock has gone without oil.

The process of preparing and applying the plumbago is as follows:—take about a quarter of a pound of the purest black-lead, the brighter the better; reduce it to a very fine powder, in a metal mortar; and to judge if it is fine enough, take a small pinch of it between the fingers; after rubbing it a few seconds, if it does not feel lumpy and gritty, but smooth and oily, it is good, and ground enough; have then a glass, full of filtered water, take up some of the ground plumbago upon the clean blade of a knife, spread it on the water, and stir it well, cover the glass, and let it stand for two or three hours; upon the top of the water there will swim a kind of film, skim it off with a card, and lay it upon a sheet of paper; when dry, put it into a box, to exclude the dust from it; put the sediment aside. Repeat the process, with some other water and ground plumbago, until you have acquired a sufficient quantity of the fine powder for your purpose. When the whole of the powder is become dry, grind it again in the mortar, or else bruise it with the back of the bowl of a silver spoon upon a clean sheet of paper, and repeat this process two or three times. If the black-lead is pure, no more sediment will go down; but if some does, wash and dry it once or twice more. As soon as no sediment falls, you may be sure that the plumbago powder is pure, and cannot cause any mischief to the pivots and holes. Then pour some alcohol (the strongest spirit of wine) into a small glass, and having previously wiped the pivots of the wheels,

and the holes in the plates, very clean, immerse them first into the alcohol, and then immediately afterwards into the plumbago powder, and they will be covered with it; then take a small brush, or hair pencil, such as is generally used by the miniature painters, dip it into the alcohol, and fill the pivot holes with it; then introduce some of the plumbago powder into them with the finger, by rubbing the plates over the holes, till the powder fills them even with the surfaces; next put in the pivots of the wheels, and make them revolve in the holes in the frame for five or six minutes; do this to the pivots of every wheel, and also repeat it two or three times. The holes and pivots will thus become charged with a thin crust of plumbago, smoother than any polish which can be otherwise given to them; *the time-piece will go twice as long without cleaning as when oil is used;* and, indeed, if its movement be entirely secluded from dust, there will be no occasion for cleaning it for twelve years! After that period the plumbago should be renewed.

The sidereal time-piece, to which I have applied the plumbago, was made with my own hands, and as its rate of going has been astonishingly good, and it is the only one of the construction ever seen, so I will give you a short description of it:—it goes eight days; the movement is not very different from others, except that the swing-wheel is at the bottom, and outside of the plate, supported by a steel cock. The pivot holes of the swing-wheel and the pallets are jewelled. The escapement is fixed upon the pendulum, and swings with it. Its pallets are susceptible of a horizontal and vertical adjustment, by means of three screws; they lock and unlock the wheel of fifteen teeth at the diameter. The vibrations of the pendulum, between the locking and the unlocking, are made in an arc of one degree and ten seconds, as marked upon the index plate; and the full swing is one degree and thirty seconds, making an excess of ten seconds of a degree on each side.

The clock is fixed to a cast-iron plate, fastened on the back of the case, and is adjusted in beat by two screws, acting laterally. The pendulum, which has three bobs, is suspended upon a *potence*, fixed at the back of the case. It has three arms; its perpendicular arm is seven inches long, and rests upon a stud at the bottom even with the pallets; its expansion is upwards, and it acts as a compensation for the length of that part of the pendulum which is between the suspension and the pitching of the pallets into the wheel. Upon the horizontal arm of the potence, and over the slit, is a screw-nut, by which the pendulum is hung; it serves to adjust the depth of the pallets in the swing-wheel. The pendulum spring is one inch broad, and its greatest flexibility is at a hole three-quarters of an inch wide; below the spring, at about six inches and a half from its most pliable part, is a plate, to which is affixed the escapement, having a perpendicular slit in the middle, wide enough to admit the cock of the swing-wheel through it, and to let the pendulum vibrate; to this plate is screwed a steel rod, at the end of which slides the pendulum-bob. Above the bob, and from its sliding-piece, branch two arms, with elbows, having a slit at each end, to admit the pivots of

two levers, which support the thermometer-bobs. On the steel rod is a brass tube, whose calibre is just wide enough to admit the rod, and to slide freely over it; this tube is fastened to the rod at its upper end, so that, by its expansion or contraction, it causes the two thermometer-bobs to rise or fall; whilst, at the same time, one acts in a contrary way, and, consequently, produces a compensation. These bobs weigh three pounds each, including one pound of mercury in each of the phials, which are inlaid at the backs of them; they slide laterally upon their respective levers to adjust the compensation. The time-bob weighs five pounds. The clock has no pulley; the weight itself, which is only ten ounces, acting as one. It has even gone with *five ounces only*, during six months! When I had a fixed observatory in Vauxhall Walk, the clock was often proved eight or ten times a day, by the transits of the sun and stars, when the atmosphere admitted; and in the last six months, and after all the improvements I deemed necessary were made, viz. from July 19, to February 24, it never varied above thirty-six-hundredths of a second from its rate!

Such have been the happy results of my experiments; and I have no doubt that such exactness in the going of the time-piece was owing, not only to the correctness of its compensation, but also to the stability of motion produced by the use of the *plumbago*. I am aware that, to those who are averse to employ care and attention, the above process will appear troublesome; but, sir, what is a day's labour once in ten years? Let those, then, whom the love of improvement, and their own reputation stimulate, try it, I am confident that their endeavours will be crowned with success. And with the pleasure of having greatly contributed to the benefit of mankind,

I am, sir, &c. &c.

L. Herbert,

Geographer at the Colonial Department.

On a new method of Colouring or Ornamenting Steel. By M. Leopold Nobili, *of Reggio, in Italy.*

This scientific gentleman was recommended to the notice of the Editor by Professor Babbage, in the beginning of the present year, as a philosopher who had much enriched galvanism by his inquiries. He brought with him several beautiful specimens of his new *Métallochromie*, or plates of steel, ornamented with regularly disposed spots, coloured of a greenish-yellow, blue, yellow, and other colours, graduated similarly to bright copper-plates, when exposed to the action of heat. The backs of the steel plates were of a uniform brown colour, thus proving that these beautiful graduated tints had been produced at a degree of heat less than that required to give brightened steel a purple colour.

In the "*Bulletin de la Societé d'Encouragement*," for January, 1829, is contained a report, made by M. Gualthier de Claubry, a member of that Society, as follows:

"A learned foreigner, known by his ingenious researches, M. Leopold Nobili, having presented to this society the results of his experiments relative to a new art, to which he has given the name of *métallochromie;* you charged your committee of the chemical arts to examine these products; and I have, in its name, to report thereon.

"A great number of experiments, more or less successful, have been made by various persons, and at different periods, to apply, in a solid manner, paintings upon metals; but the solidity of the pictures did not equal their wishes, and the thinness of the colours applied rendered their traces vague, and greatly diminished the sharpness and finish of the designs.

"M. Nobili has lately, by his assiduous researches, and the labour of many years, produced, by a process which he has not made known, designs upon various metals, in which the brilliancy of the colours, and the harmony of the tints, leave nothing to be desired; thus these colours possess none of the inconveniences above stated; and they are developed upon the surface of the metals without being too thinly diffused; but are stable, and will not disappear unless by the application of a high red heat, which, by its action, would also destroy the surface of the metal, as well as the chemical agents employed upon it.

"Nothing can be more brilliant and singular than the colours upon M. Nobili's plates, especially by day-light; and all his designs are executed with a fine taste, the regularity of their forms, and the sharpness of their outlines, being all that can be wished.

"M. Nobili has not merely manufactured these plates as objects of curiosity, but has mounted several, which have been singularly esteemed by amateurs; and we can readily believe that this pleasing art would meet with great success were it carried into effect on a proper scale; and it is, therefore, much to be desired that so new and curious an art should not be lost to France, and especially as M. Nobili appears disposed to bring it into practice. We can easily form a just idea of the extent to which it might be possible to carry this branch of manufacture, when we remark that many metals assume their colours in very different orders by the application of heat; and we can easily conceive, that in the hands of a skilful man, and one well conversant with commerce, the greatest advantages might be derived from the employment of this new branch of industry. Thus, for instance, nothing presents more harmony than gold, as its tints are very different from those afforded by heating steel. It is upon this last metal that all the designs presented by M. Nobili have been executed. Silver likewise affords different colours on applying heat; and an experienced artist cannot fail to make many fine applications of M. Nobili's process.

"This process not being exactly known, many persons have accordingly formed suppositions, and even made experiments respecting it; but it does not appear that their suppositions have been well founded; and their success has been much less happy, and their colours less perfectly developed upon the surface of the metal, than

can be effected by an art which has acquired perfection in the hands of M. Nobili.

"Under the impossibility, then, of being able to speak positively as to the manner in which M. Nobili has been able to produce these curious effects, we can only applaud the incessant efforts which he must have made to bring his art into the perfect state in which we find it. All those who have attempted new branches of manufactures, may well conceive the difficulties which every day presents, and which can only be overcome by a continued zeal and efforts to surmount unsuccessful endeavours; and M. Nobili could not otherwise have arrived at the point of perfection to which he has brought his *métallochromie*, nor can he be too much praised for the success he has obtained.

"We again repeat, that it is much to be desired that so curious an art should not be lost to France; and the Committee of Chemical Arts, in order to forward this object, have charged me to propose, that M. Nobili be recompensed for his interesting communication, by inserting this report in the *Bulletin* of the Society."

On the Manufacture of Coloured Foils.

[Translated from the *Dictionnaire Technologique* for the Technological Repository.]

These are employed by being placed underneath the precious, or artificial stones, in order to increase their brilliancy; they likewise serve for decorating works in paper, or pasteboard, and for a thousand other pleasing uses. We may easily perceive that those works are become much more perfect since we have been able to colour the surfaces of these foils, and to preserve the brilliancy of their polish, than when they were merely used in their natural state. The experiments made have been crowned with success, and a new art has been, in consequence, created. The original inventors, indeed, kept their process for tinting the foils a secret; and for a long time it was unknown. This art is now considerably extended, and even improved. As it has not, however, hitherto been described, we shall now endeavour to supply this deficiency.

When we have stated, that we employ varnishes in this manufacture, it is easy to perceive that they must be calculated to serve as coloured varnishes. We first cover the foils, or leaves of metal, with a tint of varnish, and then with another transparent varnish, which may preserve the colours from the attacks of humidity, and likewise contribute, together with the metallic brilliancy of the foils, to produce those fine effects which our customers require. We can vary the processes, according to the tones or shades of the colours; and it is easy to render them deeper or lighter. The following is the ordinary process employed:

First preparation.—We steep, for twenty-four hours, isinglass in very limpid water; and then expose it to the action of boiling water, in a water bath, in order to effect the solution of the gelatine. We

pass the whole through a double linen cloth, or a piece of swan skin, and evaporate it until the solution of gelatine assumes the form of a trembling jelly, after having been placed for two or three hours in a cool cellar.

Second preparation.—We polish the metallic leaves of silver, copper, or brass, which we would colour, and then dip them, one after the other, as we proceed, in a weak *aqua-fortis*, formed of one part of nitric acid, diluted with from eight to ten or twelve parts of water. This immersion cleanses the metal, and renders it of a lively appearance; and *instantly afterwards*, we pass the heated gelatine over it with a hair-pencil, and let it dry, in order to receive any colour we may desire, and which is effected as follows:

Blue.—We put into a small matrass, or an apothecary's phial, an ounce of fine prussiate of iron (prussian blue) reduced to powder, upon which we pour two ounces of hydrochloric acid. The mixture effervesces, and the prussiate is not long in assuming the consistence of a liquid paste. We suffer it to remain twenty-four hours; we then dilute it with nine ounces of water, and preserve the colour thus diluted in a well stopped bottle. This colour is deep; but we can readily lessen its intensity according to our wish, by adding a new quantity of water.

The leaves of silver, or of copper silvered, are better than those of brass, for foils of this colour.

Another Blue.—We take one part of fine Guatemala indigo, and two parts of sulphuric acid, and put them into an apothecary's phial, placed in a sand heat. An effervescence will take place; when this has subsided, we add ten or twelve parts of limpid water to it. This colour, likewise, is sufficiently intense to receive a large addition of water. It may be applied like the preceding, upon silver or copper silvered foils.

Green.—We can prepare this colour in two different ways; namely, either by mixing a decoction of the yellow of Avignon, with a little of either of the blues above described; or by employing a solution of the acetate of copper (distilled verdigris;) these will afford greens of different natures.

Red.—First, we can extract from cochineal a red approaching to purple; and we can vary this red by the addition of more or less water.

Secondly, we obtain another tint of red with a decoction of sandal wood in alcohol, the great volatility of which furnishes a very simple means of concentrating the colouring part more or less. We can also procure another tint by the intermediation of water, which we afterwards evaporate, and thus obtain another extract, after the operation of the alcohol. This last process, is, however, more tedious and expensive.

Thirdly, we can obtain another tint of red, from the *safranum*. We dissolve this colouring material in a solution of crystallized carbonate of soda, precipitate it with citric acid, and suffer it to dry. When it is completely dry, we dissolve it in alcohol. We can extend this colour, in successive layers, upon the metallic plates.

Violet.—We extract the tincture of litmus with alcohol, and thus obtain a deep violet, which we can lighten at pleasure, by a larger quantity of alcohol. This is to be applied in a similar manner to the preceding.

Lilac.—We enclose the litmus in a cloth tied up close, and steep it in water, as long as it will afford a rose colour; we then boil it in a new quantity of water, in which will be diffused the remaining colour; and can apply this decoction, when cold, and diluted to a convenient tint, upon the surfaces of the prepared metallic plates.

Ruby.—We heat carmine, or which is still better, carmine lake, in water; and when the decoction has boiled, we add drops of liquid ammonia to it. We suffer the liquid to settle, in the cold, and then pass it over the metallic plates, without filtering it.

Rose.—There are many ways of procuring rose colours.

First, we add to the *ruby* colour a sufficient quantity of water to reduce it to the tint we desire.

Secondly, the *safranum* affords, by diluting its colour, rose colours of various tints.

Thirdly, a decoction of Brazil wood, revived by the addition of a solution of tin in the hydrochloro-nitric acid, affords various tints of rose colour.

Scarlet or Poppy colours.—We first spread, for the poppy colour, a layer of the *ruby* colour, and over this, a second coat of the tincture of the oriental *safranum*, extracted by macerating it in cold water for forty-eight hours.

The *Capucine*, the *Aurora*, the *Jonquille*, and certain other yellow colours, may also be obtained by treating the oriental *safranum* in the above manner, and which will afford colours more or less deep.

Plumb or other *Browns.*—Apply a coat of lilac colour, and over that another of green or blue.

General observations.—We must never apply a second or third coat of colour, until the preceding ones shall have become perfectly dry. We must always avoid passing many times over the same spot, as the new layer, however cold, disturbs the preceding ones. And thus it is always advantageous to give the colour bath a tint sufficiently deep, in order to dispense with the necessity of passing it repeatedly over the surfaces.

These various tints, however, do not yet possess the solidity they ought to have, as they may easily be removed by the effect of rain, or even of a mist; and can only be preserved from their action, by covering them with a defensive varnish. That which has generally been applied to this kind of manufacture, is *the white alcoholic drying varnish.* But, if we would add to the solidity and better preservation of the tints, we should use *white copal varnish.* As this last, however, continues to diffuse a slight odour for some time, so we may cover it with a layer of *the white alcoholic varnish.* This species of manufacture, however, does not require a great degree of solidity to be given to it.

On the Employment of Iodine, and a Triple Acetate of Lime and Copper, in Dying, &c.

From the *Bulletin d'Encouragement*, 1828.

It appears, from a note by Pelletier, that he ascertained, during a recent visit to England, that a large quantity of perioduret of mercury is sold in that country under the name of *English vermillion*, which is employed, principally, in the preparation of paper hangings. Learning, also, that iodine was used in calico printing, he analysed a specimen of the colouring material from Glasgow, and succeeded in forming a compound, which was a perfect imitation of the English one. The proportions which he found to succeed best, were the following:

Hydriodate of potash,	65
Iodate of potash,	2
Ioduret of mercury,	33

This salt appeared to have cost, in England, one hundred francs the kilogramme (2 lbs. 3 oz.;) but could be prepared in France for thirty-six francs.

"It appears to me (observes this skilful chemist,) that this salt ought to be applied to the cloth before it is passed through metallic solutions. Among the latter, those which give the most beautiful colours, are the solutions of lead and mercury. This salt may be applied with advantage to cloths, by the aid of a solution of starch, which becomes of a beautiful violet colour (a known effect of iodine and starch.) The starch appears also to contribute to fix the salt on the cloth.

"There is another salt also much employed, it is said, in Glasgow, in calico printing, which I ought also to mention, because it appears not to be much used in France. This is a triple acetate of lime and copper, prepared in the large way, by Ramsay, of Glasgow, for the printers. This salt is of a very beautiful blue colour. It crystallizes in prisms, with square bases. The summits of the prisms are, however, often replaced by facets, whence result prisms with six or eight planes, according to the extension which the secondary faces acquire.

"When this salt is decomposed by a fixed alkali, the oxide of copper and the lime are precipitated combined, because they meet in the nascent state, and in definite proportions. It is certain that the precipitate turns but little green in the air, even in drying; and in its application it is a kind of verditer, which becomes fixed on the cloth. I call the attention of calico printers to this salt, which may furnish very beautiful dyes, and cannot be very expensive."

On the Preparation of Crayons, or Pastels.

[Translated from the *Dictionnaire Technologique* for the Technological Repository.]

Crayons are coloured pastes which artists use in making drawings, to which they give the name of "drawings in pastel." The best crayons come from Switzerland, and principally from Lausanne.

As they cannot, in this species of dry painting, produce the different colours or shades necessary, by mixing the principal colours, or diluting them with white, as in other kinds of painting, they are obliged to have crayons of all colours and shades.

This kind of crayon results from the mixture of any colour with a colourless base, and the whole has the consistence of a soft paste given to it, by means of a weak mucilage. This paste is afterwards formed into small cylinders, and dried; but as it is indispensable that the crayons should readily extend upon the paper, and apply themselves in a smooth uniform layer, without any grittiness, so it results, that we cannot indifferently employ, for making them, every kind of colour, basis, or mucilage; as there are some colours which, in drying, acquire too great a degree of hardness, and which they communicate to all the crayons of which they should form a part; and there are others which are susceptible of becoming more coherent with one vehicle than with another. It is the same with the mucilages also, which might give too great a degree of hardness to one kind of paste, and too little to others. And we have, therefore, to make choice between them, and to vary their proportions, in order to form crayons which should possess all the requisite qualities.

We have before mentioned, that it is particularly necessary that the crayons should readily extend upon the paper, and in uniform layers; but these conditions cannot be fulfilled, unless the particles composing the paste be exceedingly minute, and be held but slightly together. And thus, the best means of separating the molecules, and giving them the requisite degree of minuteness, is by employing the method known by the term *levigation;* and which consists in adding to the bodies, previously reduced to a fine powder, a considerable quantity of water, and stirring the whole until it forms a uniform mixture; this must be suffered to remain a few moments at rest, and then be poured off. This will at length deposit, as we can readily conceive, a powder, which is much more subtle than the former one. In fact, as the molecules are larger, so they are heavier, and precipitate in much less time than the former or smaller ones. This method of proceeding equally applies to all the bases, as well as the colours. After this statement, we must add, that the most usual bases or excipients of the colours of crayons, are either washed chalk, or the white or tobacco-pipe clay; sometimes, indeed, but rarely, we also employ calcined gypsum, the oxide of bismuth, the sub-carbonate of lead, or ceruse, and also starch or flour. It is to be presumed, that the magnesian earths, which are ordinarily so soft to the touch, also offer some advantages in this respect; the bolar earths, and the ochres, which are nothing else than clays naturally coloured by the oxides of iron, may also be usefully employed in the preparation of crayons.

When we have selected that base which is most convenient to mix with the colour that we would employ, we must also seek for that species of mucilage to which we ought to give the preference; in order that the crayons, after being dried, should preserve the necessary degree of consistence; and here the only sure guide is experi-

ence; that is to say, we must make trials on a small scale, when we first begin to form this kind of composition. Thus, to bind these pastes, we usually employ the mucilage of gum arabic, or still better, that of gum tragacanth; but we must also make the mucilage more or less thick, according to our design; that is to say, we must dissolve in the same quantity of water more or less gum. In general, the preference is given to gum tragacanth, because an equal weight of it furnishes a more abundant mucilage, and, consequently, there remains a less weight of it in the paste after dessiccation.

When the pastes require but a slight degree of agglutination, we add to the mucilage of the gum a little sugar, in order that it may acquire a less degree of hardness in drying; or we may substitute for the mucilage, either a simple decoction of malt, or milk. Sometimes, also, the addition of a little soap-lees produces a good effect. Finally, we also incorporate, with certain pastes, and principally those in which alumine forms a part, fatty bodies, such as oils, wax, or suet; and we even entirely replace the mucilages, or other viscous materials, by a mixture composed of sixteen parts of suet, four parts of wax, and one part of spermaceti. But we can only use these crayons upon canvass, or pasteboard, coated with oil varnish, and dusted over either with powdered glass, or pumice stone in powder; they are, indeed, more difficult to use, but then the pictures produced have more solidity than those made with the ordinary crayons.

After giving these general details, it now remains that we indicate the processes for the preparation of crayons or pastels. We commence by making what are termed the primitive pastes, and which are afterwards mixed with other ingredients in different proportions, in order to obtain all the required shades of colour. Thus, we grind in the usual manner, the colour which is to enter into the paste; we then add, by grinding, a sufficient quantity of the base, or excipient, to form a shade which may serve as a type or pattern, we then divide this into as many portions as we would obtain other shades, and incorporate with each, a progressively increasing quantity of the white base, or excipient. Thus, in the first portion we put, for instance, one part; in the second, two parts, &c., until we have formed all the gradations of tint we require. We may readily conceive, that this method equally applies to other colours mixed with the primitive ones, and that it is easy, by this means, to obtain from them all, every colour, and of every requisite gradation.

It is easy to perceive that it would be inconvenient to dispose of a great number of these pastes at once, especially in summer, as the masses would dry at their surfaces, before they were formed into crayons, and thus produce lumps, which would mix but difficultly with the remainder of the paste, and thus render it gravelly. Supposing, then, that we have only prepared a certain number, and that we would form them into crayons; we commence by drying the paste a little, between doubled unsized papers, and when the excess of humidity is thus absorbed, and the paste can be handled without adhering too much to the fingers, we divide it into small masses, which we first form into balls between the palms of the hands, and then

roll them between the flat part of the right hand, with a backward and forward motion upon a well dressed, flat and smooth, wooden plank, upon which are also affixed two small parallel rods or bars of an equal thickness, and which are placed at right angles to the workman. The paste is thus formed into long cylinders, and when they begin to be of a diameter nearly equal to the thickness of the bars, in order to reduce them to the required thickness, we substitute a piece of flat and smooth wood for the hand, and whose length exceeds that of the width between the two rods, and is gradually tapered away at each end, so as to form handles. We continue this backward and forward movement until the piece of wood rests at each end upon the two rods. The cylinders thus acquire length, and it then only remains to divide them, by means of a knife, into the lengths which we would give to them. They are usually about two inches long. In order to cut them without flattening their ends, we should take care to apply the knife, whilst rolling the cylinders.

When we have taken care to press the paste well in rolling it, in order to drive out any particles of air which it enclosed, we shall obtain crayons which will break with a homogenous fracture; but if, on the contrary, we have neglected to take this precaution, they will be too fragile, and their fracture will be cavernous. In this case it will be difficult to use them upon paper, and we think that in order to obviate this inconvenience, and without being obliged to have recourse to a manipulation much longer than this we have described, the rolled paste might be strongly compressed between two channels which exactly correspond, and thus form a cylinder of the exact dimension we would give to the crayon. Others, on the contrary, employ a mandrel formed of polished brass, from eight to ten inches long, and slightly conical. They roll upon this mandrel a thin leaf of tin (tin foil,) and then take it off the mandrel; into this kind of mould they pour the paste, made a little more liquid than in the preceding case, and then leave it to dry slowly. When the crayon has become of a certain consistence, they remove the tin mould.

Amongst the crayons usually sold, and which we submitted to trial, we laid aside those which were not of a proper quality; that is to say, those which were either too hard, or too fragile. We remedied the first fault, and which is usually occasioned by their containing too large a proportion of plaster of Paris, by again grinding up the crayon with a little milk and water, and then proceeding in the manner above indicated. And we obviated the second defect, which evidently proved the want of a binder, by adding a little to them thus; we ground them up with a sufficient quantity of water, and then incorporated more or less clay with them, as was required.

We are obliged to take great care in avoiding the breaking of the crayons. Generally they are contained in flat boxes, where they are disposed in parallel rows upon cotton. Each colour, and its gradations, occupy distinct places, for the facility of using them.*

* We have before mentioned, that we sometimes employ fatty substances in making certain kinds of pastels or crayons. We find in an old Dictionary of

We think that what we have above stated, might be sufficient to guide those who have a sufficient knowledge of colours, and of their preparation; nevertheless, we shall add thereto a certain number of receipts, or at least indications, which we find in the *Traité des Couleurs, by* M. I.—Ch. Leuchs.

White Crayons.

"1st. Pure chalk, well washed without any other preparation.

"2nd. White lead (*ceruse*) ground with milk, and dried in the shade; if they should not possess sufficient solidity, a little gum may be added to the milk.

"3d. The white oxide of zinc, treated in the same manner. Or we may also use the sulphate of barytes, magnesia, or calcined bones."

We may observe with respect to the white from zinc, that it possesses a great advantage in not becoming black, as is the case with white lead, by exposure to sulphureous vapours. We can employ that oxide of zinc, which is known in commerce by the name of flowers of zinc; but, as it likewise always contains some grains of metal, so it is essential to commence by separating them, by mixing it with water, and passing it through a sieve, placed over an earthen vessel; the oxide passes through the sieve, but the grains of metal are retained in it.

The sulphate of barytes is of too dry a nature to make good crayons. The calcined bones, which are, as we know, entirely composed of phosphate of lime, are likewise in the same predicament, though in a less degree; but it is possible to give this salt a different preparation, which renders it much more applicable to this purpose. We treat the calcined bones by the sulphuric acid, as in the process for making phosphorus; we then saturate the acid phosphate of lime,

the Arts, the following receipts. The first is due to a German painter, named Reifftein; it consists in first reducing the colours, by grinding, to a very fine powder, and then incorporating this powder with a mixture of wax and suet. This mixture is to be ground up in a small vessel, exposed to a very gentle heat. When the mixture is become nearly cold, it must be cut into small portions, which are to be placed between double blotting paper, in order to absorb the excess of fat in the crayons, and thus to give them a consistence, when they are to be thrown into cold water. These crayons, as we before observed, can scarcely be used upon common paper.

We also find another receipt, given by a painter named Bachelier, who had found the means of preparing two kinds of crayons; the one soft and tender, so as to be capable of extending between the fingers, and which might be fixed, by exposing the drawing made with them to a slight degree of heat, as is practised with the paintings in encaustic. He was not so sanguine as to the durability of the drawings made with the others. To prepare the first kind, he dissolved salt of tartar in warm water, to saturation; he then filtered it through paper, placed it over a gentle fire, and dissolved white wax in it; the result was, a kind of soap of wax, of the consistence of boullie, and very soluble in water. When he would prepare crayons, he dissolved a little of this soap, and used the solution to incorporate with the colours, and make a paste, which he cut and formed into small pastels, proper to make fixed drawings by afterwards heating them. To make them harder, he placed them under a muffle, and gave them a small degree of heat. We might make coloured drawings with these crayons, which, according to the assertion of this artist, would not alter.

which we obtain by lixiviation, by means of the sub-carbonate of soda, which remains in solution; and the sub-phosphate of lime, which, being insoluble, is precipitated. We then wash it well with a large quantity of water, filter it, and obtain this new phosphate of lime, which no longer possesses the rigidity of the bones, but, on the contrary, has a great tenuity, and is of a fine dead white colour.* A slight calcination renders this white still more clear; but we must take care that the washing has been perfectly performed, otherwise, if any phosphate of soda remains in it, it will form a kind of *frit* of great hardness.

Yellow Crayons.

"1st. Natural ochre, ground up with more or less gum water, and formed into crayons.

"2nd. Mineral yellow, Naples yellow, chrome yellow, or turbith mineral, either ground separately or with chalk, and gum water, and put into form.

"3d. Orange arsenic, treated in a similar manner. These crayons must not be employed with those made of white lead."

We can also obtain fine shades of yellow, by mixing, in various proportions, a solution of alum with solutions of iron, at different degrees of oxidation; then precipitating the whole by the sub-carbonate of soda, washing the precipitate, and either simply drying it, or submitting it to a calcination more or less great.

It is to be regretted that the *sulphuret of cadmium* is so dear, as it is not only of a fine yellow colour, but, which is of more consequence, it is not, like the above, likely to change from exposure to vapours.

Red Crayons.

"1st. Soft red chalk, red earth, or bole, either ground up with milk or gum water.

"2nd. Vermillion, brown red, chrome red, either singly, or mixed with white earths; and rendered solid by gum tragacanth.

"3d. Lakes of Brazil wood, madder, or carmine, mixed with clay, and sometimes with starch; and rendered solid with the yest of beer, milk, or gum water.

Blue Crayons.

"1st. Prussian blue, or indigo, ground with the decoction of malt.

"2nd. Smalt, or cobalt blue, either singly or with chalk, and ground up with gum tragacanth water.

Green Crayons.

"1st. Green earth and chalk, ground up with gum water.

"2nd. Brunswick green, or any other green colour from copper, ground up with gum water.

"3d. Yellow and blue mixed.

* Surely this preparation must form an excellent white colour for miniature painting.—Editor.

Brown Crayons.

"Umber, single, or ground up with chalk and gum water.

Black Crayons.

"1st. Willow charcoal.

"2nd. Lamp-black calcined, with a little umber, indigo, and gum, or the decoction of malt."

We are obliged to M. Ferrand for communicating the following receipts, which he has put in practice with success, in his colour manufactory at Paris.

Blue Crayons.

As Prussian blue acquires too great a degree of hardness in drying, we can obviate this inconvenience in the following manner. We treat the Prussian blue, by heating it in concentrated sulphuric acid, and then adding a large quantity of water; the blue, which at first disappeared, is then reproduced, but in a perfect state of division. We suffer it to precipitate, and wash it well in several waters; then we add to the blue, in the state of a *bouillie*, a mixture of equal parts of chalk and magnesia, both of which had previously been properly prepared; and, finally, we wash it again once or twice, in order to remove a little sulphate of magnesia, which forms itself, as well as all the acid, which was not before entirely freed from it. We then drain it and dry it, and finally grind it up with a sufficient quantity of water to make a paste, which we form into rolls or cylinders, without adding any gum.

Red Crayons.

The carmine lakes, which contain much alumine, are subject to the same inconvenience as the Prussian blue; that is, they make crayons which are not soft enough. We obviate this defect in the following manner. We tinge with red the chalk of Champagne, mixed with a fourth part of magnesia; in order to do this, we employ cochineal, which we boil with a little alum; we then put this decoction, after straining it, into an earthen vessel; the alum is decomposed, and the alumine, on separating, entangles with it the colouring matter, and the liquor is found colourless. We repeat this process until the chalk is become sufficiently tinged, then dry it, and mould it in the usual manner. R.

On an Apparatus for Evaporating Sirops.

[From Ferussac's *Bulletin des Sciences Technologiques.*]

This apparatus, which has been recently established in France, and for which the inventor has obtained a brevet, is chiefly remarkable for its great simplicity. A copper boiler, hermetically closed, and some wooden vessels, in fact, compose the chief part of the apparatus. The vacuum is made by steam, and the steam is afterwards condensed by cold water, so simple is the process. The apparatus

does not require the employment of any pump, nor of any other auxiliary machine, as it performs its functions without motion. And thus, not only is the vacuum produced and preserved without the aid of the pneumatic pumps, which are employed in Howard's English apparatus, but the water necessary for the condensation, rises of its own accord into the reservoir destined to receive it, and which is elevated from eight to ten feet above the surface of the earth. The management of the apparatus is also much less complicated than that of Howard; and thus a workman possessed of the least degree of intelligence can govern it; in fact, it is reduced merely to the turning of a few cocks! The steam is also produced under the ordinary pressure, which removes all idea of danger. The proofs are taken by drawing out the boiled sugar into threads, as usual; and an instrument is applied to the boiler, which permits us to extract a small portion of the sugar from time to time, and without suffering the air to enter the boiler. This instrument differs entirely from that used in Howard's process, it is not only more simple, but is also more convenient.

M. Leclerc, a manufacturer of sugar from the beet root, is the first person in France, who has adopted this new apparatus at his sugar refinery, near Péronne. He employs the steam produced from a covered boiler, in which the juice is concentrated before it is clarified. This boiler thus serves as a steam generator. The steam thus produced heats the boiler (the vacuum pan of Howard's apparatus) in which the sirop is brought into a state of ebullition. The withdrawing of the atmospheric pressure from its interior, permits us to obtain this ebullition without heating the steam to more than eighty degrees of Reaumur's thermometer. The sugar boiling is thus effected at a temperature of from fifty to sixty degrees. It depends upon the workman to regulate this internal heat, and which he can raise or lower at will. Experience has, however, proved, that it is necessary to elevate it to sixty-eight degrees towards the end of the boiling, in order to give the sirop the temperature necessary to produce a good crystallization of the sugar. This effect, however, is still obtained, without suffering the air to enter, or injuring the vacuum. The internal pressure is indicated by a mercurial gauge, which varies in its range, according to the density which the steam has acquired. The exclusion of the air is perfect, and the vacuum is maintained without being perceptibly weakened during the whole course of operation, prolonged, as we see, many hours. Whereas, in order to produce a vacuum in Howard's apparatus, pumps are required, which must possess a degree of perfection difficult to give them. M. Roth's apparatus is capable of being established upon any scale which may be required, and in all localities. The want of water need be no obstacle. Firstly, the quantity required, is much less than that which is employed in the English sugar refineries, it is about a fourth part only; three litres and a half of water being required for each litre of sirop. And, secondly, it is possible, and even advantageous, not to replace that which has served for the condensation. On leaving the apparatus, it has acquired a temperature

of from forty to forty-five degrees; and it is received into a reservoir, placed outside of the buildings. After arriving at this reservoir, its surface is not long in cooling. The tube of aspiration, intended to elevate it again to the apparatus, takes it from the bottom of the reservoir; this alternate motion of rising and falling, may be continued, with the same mass of water, for a longer or a shorter time; nay, it may be prolonged indefinitely, provided the water is not suffered to become putrid. This inconvenience may be avoided by saturating it with lime.

The vacuum pan, in M. Roth's apparatus, evaporates from an equal surface, with much greater speed than an open boiler, placed over an open fire. When established upon a proper manufacturing scale, one pan will boil nearly 4000 litres of sirop daily.

We can believe, after what has been above stated, that the expence of establishing this apparatus cannot be great. According to report, it is beyond all comparison, in this respect, with that of Howard. Its construction is solid and simple, and the absence of all friction renders the keeping of it in repair easy, and, of course, at but little expense.

The advantages which it presents, are, first, to produce an economy in the heating; secondly, the boiling the sirops without weakening them, and thus affording better and more beautiful products; thirdly, making more sugar, and less molasses (about ten per cent.;) fourthly, shortening the time of claying the sugar; fifthly, causing the inconvenient and noxious vapours usually produced from sugar refineries to disappear; and, lastly, to procure a great quantity of hot water, applicable to various purposes.

Remarks by the Editor of the Technological Repository.—Our readers will find two of the late Mr. Edward Howard's patents for sugar refining, in our *Technical Repository*; and Mr. Barry has a patent for evaporating sirops, &c. in a vacuum, produced much in the above manner. We greatly doubt the success of M. Roth's apparatus; but if it should prove to be capable of producing the effects stated, and in so simple and facile a manner, it will produce a wonderful alteration in the present system of sugar refining. We believe that the use of Mr. Howard's excellent, but expensive apparatus, is not now extending here, although we know that it has been lately adopted at Vienna.

On Preparations for Dying the Human Hair. By M. Gendrin, M. D.

[From "*L'Indust.*" or *Revue des Pays Bas.* 1829.]

The formulas of the preparations for dying hair are numerous; they may, nevertheless, be reduced, with respect to their mode of action, into two classes: the first, comprehends all those by which *iron* is caused to penetrate the hair in a determinate proportion, and which is afterwards changed *black* by the action of *gall nuts*. The

second comprises those formulas in which sulphur is employed, and made to penetrate the hair; and being afterwards susceptible of becoming black by combination with those substances which are black in the state of sulphurets.

To the first kind belongs the following formula, which is given by Forestus.

Take red wine, one *livre;*
muriate of soda, one *gros;*
sulphate of iron, two *gros;*
Boil them for some minutes, and then add,
oxide of copper, one *gros.*

Make them boil for two minutes, withdraw them from the fire, and add,

pulverized gall nuts, two *gros.*

The hair and beard must be well rubbed over with this composition, and some moments afterwards with a warmed linen cloth, and then be washed with common water.

The following formulas are of the second species:

Take oxide of lead, two parts;
slaked lime, one part;
chalk, two parts.

Mix them with water, and dip a hair-pencil or brush into the preparation, with which the hair must be well rubbed; and at the end of two hours it must be washed, and the effect will be produced.

This last formula is the most generally employed, and is exempt from any inconvenience. Notwithstanding all that has been published against the practice of dying the hair, yet a great number of persons have recourse to it, and without experiencing the least accident. In this preparation there is produced a black sulphuret of lead, which is combined with the hair. The lime, when diluted by the chalk, loses that causticity which rendered it noxious.

We likewise frequently employ the following preparation, which is more active.

Take quick-lime, in the stone, one *livre;*
yellow litharge;
white lead, of each one ounce.

Dissolve the lime in water, and add, by degrees, and constantly stirring all the while, the oxides of lead.

There likewise belongs to these kinds of preparations, another, but which possesses serious inconveniences: this is a mixture of lime and nitrate of silver. This mixture, which, indeed, blackens the hair, nevertheless produces an erysipelas on the skin, in which the hair is implanted; and its use ought, therefore, to be prohibited.

Description of a Safety Chair for Glazing, Painting, or Cleaning Windows. By William Baddeley, jun.

A great number of distressing accidents frequently occur in various parts of the metropolis, by persons being precipitated into the

street while cleaning the outside of windows, &c. Nor is the occurrence of these accidents confined to servants, who imprudently venture to sit, and sometimes even to stand, on the exterior of the window sill; for glaziers find, to their cost, that continual employment in this avocation is not at all times sufficient to ensure their safety. A short time since, one of these men fell from a window, and was impaled upon the iron railings of a house in my own neighbourhood, from whence he was extricated with considerable difficulty, sadly torn and mangled. After lingering a few hours, in the most deplorable condition, death terminated his sufferings. It is to be regretted that this is only one of a great number of melancholy instances, which show the necessity of employing some means or other to remove the great risk attending the cleaning or painting the exterior parts of a building.

Various machines have, from time to time, been constructed, to prevent a recurrence of accident,—several of them of considerable ingenuity; but most of them were cumbersome, and caused so much damage to walls, &c. in being carried up and down stair cases, narrow passages, &c., that they soon fell into disrepute.

A "Portable Balcony, or Domestic Life Preserver," has been invented by Mr. Gregory, whose active exertions in the cause of humanity (both in the present instance, and also in the great attention he has paid to the means of providing escape from fire) entitle him to the gratitude of society. The machine of Mr. Gregory is by far the most convenient for this purpose that has hitherto been constructed. It allows the most timid female to stand on the outside of any window, with the most perfect security; and is, for glaziers' use, far preferable to the machine usually employed by them.

One of these machines may be seen in the National Repository; and, perhaps, the following sketch, from memory, will give your readers a tolerably correct idea of its construction:—

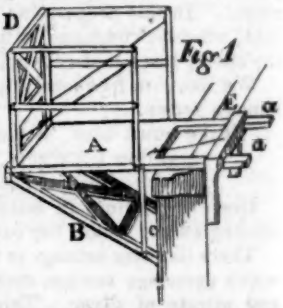


Fig 1

On the under side of a flat board, or platform, A, (Fig. 1,) is fixed by hinges, a frame with two legs, B, also connected, near the extremity, with the platform, by double joint irons, *c*. A back, D, with one vertical and two horizontal side rails, is also jointed to the upper side of the platform. By thus connecting its several parts together by centerings, the machine is capable of assuming a very portable form,—the whole folding together quite flat (as shown in Fig. 2;) in which state it can be carried about with the greatest facility, and without injuring the narrowest staircases or passages.

Fig 2

In using this machine, the legs, B, are first separated, to their full extent, from the machine, (as in Fig. 1,) and are placed upon the outside of the window. Two arms, *a a*, project from the platform

to a short distance within the room. Upon these arms a small frame, E, having two legs, slides; and when brought close up to the inside of the window, is secured there, either by pins, or, what is more generally preferred, by a cord, which passes from the top of the frame, and is wound round a hook near the middle of the platform. The back and side rails are then raised, and are retained in the elevated position by an iron rod and hook on each side, proceeding from the lower part of the back, and fitting into an eye on the upper part of each of the side rails, forming a strong diagonal bracing.

It is needless for me to enlarge upon the merits of this contrivance, as they must appear self-evident to every one, on its first inspection. It has already met with extensive patronage, both in private families and public establishments, as well as from several intelligent glaziers, who have adopted it in lieu of the unsafe machine hitherto employed. Certain I am, it only requires to be better known, to be yet more extensively employed. The price is two guineas; and when the numberless occasions on which it is required are taken into consideration, the expense is trifling, compared with the solid advantages to be obtained by its adoption. [*Mechanic's Magazine.*

FRANKLIN INSTITUTE.

The Twenty-fourth Quarterly, or Sixth Annual Meeting of the Institute, was held at their Hall, on Thursday evening, January 21, 1830.

James Ronaldson, President, in the chair.

William Hamilton was appointed Recording Secretary, *pro tem.*

The minutes of the last quarterly, and also of the meeting held this afternoon to appoint tellers, and to open the poll for the election of officers and managers for the ensuing year, were read and approved.

The annual report of the board of managers, and also of the treasurer, were severally presented and read, whereupon it was Resolved, that the reports be accepted, and that the report of the board of managers be referred to the committee on publications, to publish so much thereof as they may deem expedient, together with the minutes of this meeting.

The tellers appointed to receive the votes of the members for the officers and managers of the Institute for the ensuing year, presented their report to the president, who declared the following gentlemen duly elected:

James Ronaldson, *President.*
Isaiah Lukens, Thomas Fletcher, } *Vice Presidents.*
Isaac B. Garrigues, *Recording Secretary.*
Isaac Hays, M. D. *Corresponding Secretary.*
Frederick Fraley, *Treasurer.*

Managers.

Samuel V. Merrick,	Charles H. White,
Abraham Miller,	George Fox,
Adam Ramage,	Andrew Young,
Ashbel G. Ralston,	Christian Gobrecht,
Rufus Tyler,	Thomas Scattergood,
John Struthers,	Thos. M'Euen, M. D.
John O'Neill,	Thomas Loud,
Matthias W. Baldwin,	James Rowland, jr.
Joseph H. Schreiner,	Benjamin Reeves,
Samuel J. Robbins,	Thomas U. Walter,
Henry Horn,	James M. Bolton,
Mordecai D. Lewis,	Charles H. Kirk,

On motion, adjourned.

JAMES RONALDSON, *President.*

WILLIAM HAMILTON, *Recording Secretary, pro tem.*

Sixth Annual Report of the Board of Managers of the Franklin Institute.

To the Franklin Institute of the state of Pennsylvania, for the Promotion of the Mechanic Arts, the Board of Managers make the twenty-fourth quarterly report.

AT the conclusion of another year, the board of managers in surrendering the trust which has been committed to them, in compliance with the requirements of the constitution, present to the members of the Institute a view of its transactions. It is gratifying to observe, that the operations of each succeeding year contribute more fully to establish the character and extend the influence of the institution. The objects for which it was established being now well understood, and, consequently, justly appreciated, all that is required to give permanency to the institution, is the fostering aid of the community, which the board entertain the most confident hopes will not be withheld.

From the committee on instruction, the board have received, from time to time, detailed reports on the various subjects embraced within their jurisdiction. In the month of August last, the High School ceased to be under the control of this committee, having completed the term of three years, for which it was originally established. The board are duly sensible of its merit, and public utility, and do not doubt, that, under its present organization, it will continue to be the means of the diffusion of education, upon terms so moderate, as to place it within the reach of all who desire to avail themselves of so valuable a privilege.

The regulations for admission to the lectures, have been attended with the most beneficial results, and the attendance during the present season, has been much greater than on any of the preceding ones. Every exertion has been made by the Professors to explain and illustrate their several departments of science, and from the in-

terest which has been excited, it is believed their efforts have been successful.

The board are under great obligations to Peter A. Brown, Esq. for his course of volunteer lectures on geology, during the present season. Arrangements have been made for the delivery of volunteer lectures during the remainder of the term.

The drawing school has excited a degree of interest which is unexampled, and its numbers have increased so rapidly, as to prevent the admission of several applicants. It is to be hoped that this interest will continue, and that apprentices and others will duly appreciate the advantages of this school. The board regret that the operations of the mathematical school have been altogether suspended, by the continued illness of the instructer, Mr. Levi Fletcher.

The flattering prospects held out in the last report, in relation to the Journal of the Institute, have not been fully realized. Considerable exertions have been made by the editor, and the publishing committee, to render it a more original work, but as yet, they have met with but partial success; nor can they hope completely to effect their object without a more general co-operation of the members of the Institute. There are many well qualified to give aid, by contributing observations on their daily practice, which would increase the interest and utility of the work. The board beg leave again to call the attention of the members to this department of their labours, under the hope that it will meet that attention, which, from its importance to the arts, and to the well being of the institution, the subject deserves.

The interest taken in the Journal by subscribers, has been greatly increased by the analysis of patents, which has occupied a large portion of it during the past year.

To those whose attention is called to the construction of new machinery—the knowledge of what has been done or attempted by others, is of incalculable value; and to them a work giving a description of all new inventions, as they appear, must be an acceptable offering. The board deem the policy of giving publicity to patents, too evident to need an argument.

The plans and improvements laid before the committee on inventions, during the past year, have been more numerous than heretofore; several of them have been deemed useful and valuable, and have been reported on, favourably. The reports, in many cases, have already been presented to the monthly meeting; others, being on incipient inventions, have from necessity been retained by the committee; their rule having been not to make public any report which is unfavourable, nor to make an invention known without the consent of the inventor, excepting where the invention has been referred to them by the monthly meeting.

How far their decisions have been deemed just by the projectors, the board are unable to say, but it may be fairly inferred from the increased number of the applicants, that the confidence of the public in the judgment of the Institute, is undiminished.

Your board would beg leave to call the attention of the Institute to the cabinet of models. Since the first year of our institution, no additions have been made by purchase. The limited amount of funds within the control of the board has prevented them from appropriating any to this use, excepting for such models as were absolutely necessary, at that time, for the lectures. Nor do they see any prospect of increased means for promoting this object. This interesting department must, therefore, depend on private donations for its support. Hundreds of models are, probably, in existence in this city, of little service to their owners, which, if collected, would be of great value for reference. If it be thought too much to ask the donation of a valuable model, it would be of great service to the arts to make the Hall of the Institute the place for their deposit. The board feel assured that if an example were set by some public spirited individual, it would soon be followed, and the Hall of the Institute become a valuable depository of the works of art.

The board with pleasure recur to the flourishing state of the library. Like the model collection, it had languished unaided by the funds of the Institute; but of late a spirit of liberality has been manifested towards this department, by the members, and others, and many valuable additions have been made. The cases allotted for it are nearly full, and if this spirit is maintained, the board anticipate soon having to make further arrangements for its accommodation, and a hope may confidently be entertained that it will, at an early period, be made more available to the Institute, and afford increased means of diffusing information.

The cabinet of minerals, though not of such general interest, has not been overlooked; it has, since the last annual report, assumed a more tangible shape; cases have been provided for its reception, and although not yet systematically arranged, it may be examined with profit. This department has attracted the attention of several scientific and liberal members, under whose fostering care the collections will soon be of considerable extent and value, and add still further to the means of our improvement.

Early in the present year, your board determined on a course of experiments to determine the value of water as a moving power, and the most economical means of applying it. With a view to the attainment of this end, they appointed a committee, whom they authorized to make applications for pecuniary assistance to those interested, and also to the city for the use of a room in the Fair Mount water works. On due consideration, that committee determined that experiments on so small a scale as the fall at Fair Mount would admit of, would not be satisfactory; they, therefore, applied to councils for permission to use the water from the pipes, and to the corporation of Spring Garden, for leave to take up the pipes within their jurisdiction; both which requests were cheerfully granted, and an ample supply of water for their experiments thus obtained.

The Institute are under great obligations to Messrs. Rush and Muhlenberg, for the use of their lot at the corner of Ninth and Vine

streets, which they readily granted, although it is probable that the premises will be occupied for a considerable length of time.

During the past summer, the committee have been assiduously attending to the duties assigned, a task which proved of more magnitude and difficulty than at first appeared.

They have completed the requisite works, and one wheel of twenty feet diameter, at a cost of about $1300. As the works were not prepared for experiment till early in December, the committee deemed it most prudent to suspend their operations until the severity of winter has past, that they might pursue their investigations without interruption. In the meantime, they are continuing their exertions to collect sufficient funds to enable them to prosecute their inquiries to the utmost extent, under the hope, that the spring may open with better prospects to manufacturers, when they may obtain funds sufficient for their expenditures.

The plan adopted for measuring the effect produced, is by raising a weight: this, though liable to some objections, appeared under all circumstances to be the best. Since the suspension of their operations, the committee have received from Warren Colborn, Esq. of Lowel, Massachusetts, the description of an apparatus lately invented by him for weighing the power of machines. This plan the committee have had under consideration, and so far as they are able to judge without trial, are of opinion is better adapted for its purpose than any they are acquainted with. They have not yet determined to substitute it for the method previously adopted, but if their funds admit will construct one; the cost estimated is 150 or 200 dollars, and their expenditures have already exceeded their estimate.

The committee on premiums and exhibitions have, for some time past, been actively engaged in preparing a list of premiums to be offered at the exhibition to be held in October next.

Taking advantage of past experience, the board have determined, in some measure, to change the character of the exhibitions, and open the Hall rather as a depot for the display and sale of the products of our workshops, than as a place where they will come directly in competition, and be subject to invidious comparisons. The board propose to confine the premiums to inventions and manufactures but little known, and, perhaps, to some few essays on subjects tending to advance our knowledge in the mechanical sciences; leaving all specimens, the sole merit of which is in the workmanship, to be judged of by a discerning public, well knowing that all of our deserving mechanics who expose their products to public view, will meet a full reward according to their merit, by an increased custom, and be compensated for the immediate trouble they are at, by the sale, at the Hall, of the articles they present. The Institute will, by this arrangement, avoid that odium which must necessarily fall on them by disappointing many of the competitors, while the great object for which these exhibitions were instituted, will be equally well subserved.

Your board are convinced that the monthly meetings of the members of the Institute, have been attended with the most beneficial

results. The interest of numbers has been excited; they have occasioned a free discussion and interchange of opinions upon interesting and important subjects, whereby much practical and valuable information has been elicited; and they have been the means of adding valuable articles to the library and cabinet of minerals. The board, therefore, strongly recommend the subject of the monthly meetings to the attention of the members, and hope they will continue to evince an interest in them.

The treasurer's report is herewith submitted, showing a balance in the hands of the treasurer of 763 dollars 76 cents.

During the past year, the following gentlemen have paid to the treasurer the amount specified by the constitution to entitle them to a membership for life, viz. *Messrs. John Rorer, Mark Richards, George Robinson, C. C. Biddle, Joseph Fisher, Adam Ramage, Reuben Haines, and J. H. Fisler.*

The board now surrender into your hands the trust delegated to them, under a full conviction that they have endeavoured faithfully to execute the duties entrusted to them, and they indulge the hope that their acts will prove satisfactory to the members of the Institute.

All which is respectfully submitted.

Monthly Meeting.

The stated monthly meeting of the Institute was held on Thursday evening, December 24, 1829.

Mr. Samuel V. Merrick, was appointed chairman.

The minutes of the last meeting were read and approved.

The following donations were received, viz.

The first nine volumes of the American Museum, presented by Mr. M. D. Lewis.

The fourteenth volume of the American Museum, presented by Mr. A. S. Roberts.

The corresponding secretary also laid on the table the works received in exchange for the Journal of the Institute, viz.

Journal of Education, Nos. 38, 39, 40, and 41.

London Journal of Arts and Sciences, for November, 1829.

Gill's Technological and Microscopic Repository.

Journal des Connaissances Usuelles et Pratiques, for September and October.

Journal Universel des Sciences Médicales, for August.

Bibliothéque Physico-economique, for September.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, for August.

Recuel Industriel, for August.

Annales de Chimie et de Physique, for July.

The paper submitted at the last monthly meeting, by Mr. Charles Potts, in reply to the query "what is the proper method of computing the power of high pressure steam engines, and by that meet-

ing deferred to this, was called up and read, and referred to the committee on publications.

On motion, the query, "what is the rationale of the action of the hydrogen gas on platina sponge, as discovered by Doebereiner?" was selected for discussion at the next meeting.

Extract from minutes.

SAMUEL V. MERRICK, *Chairman.*
ISAAC B. GARRIGUES, *Recording Secretary.*

Reply to the question, What is the true mode of Computing the Power of a High Pressure Steam Engine. By Mr. CHARLES POTTS. *Read at the meeting held December* 24, 1829.

TO THE FRANKLIN INSTITUTE.

FROM the dynamical relation, that the force or power of an engine is equivalent to the momentum, or quantity of motion which it is capable of producing, we shall have, putting F, for the *efficient force* of the steam on the piston of the engine, A equal to the area of the piston, V the velocity when the performance of the engine is the greatest, and P the power of the engine. $P = A \times F \times V$. Or, as it is usual to compare the power of the engine with that of horse power, let S be the standard of comparison, then $P = \frac{A \times F \times V}{S}$

This rule which answers for computing the power, either of the high or low pressure steam engine, may be otherwise expressed in words, thus,

Multiply the area of the piston by the efficient force of the steam acting thereon, this product being again multiplied by the number of feet the piston travels when the effect of the engine is the greatest, and divided by the standard of horse power, the quotient will be the relative power of the engine.

To illustrate the above rule, let us take for an example the following case. A low pressure engine, having a cylinder 24 inches diameter, makes 20 strokes per minute, each stroke being 5 feet long; the efficient force of the steam being equivalent to a pressure of 10 lbs. per square inch. Here $A = 452.4$ square inches, $F = 10$ and $A \times F = 4524$ lbs. the whole pressure on the piston, or the weight which the engine raises with a certain velocity. To find the velocity we say the engine performs 20 *double* strokes, each 5 feet long in a minute; hence $V = 20 \times 2 \times 5 = 200$ feet, the rate at which the piston travels per minute. If we assume $S = 32.000$ lbs. according to Bolton and Watt, then $P = \frac{A \times F \times V}{S} = \frac{4524 \times 200}{32.000}$ $= 28\frac{1}{4}$ horses, the power of the engine, the engine being supposed to work only eight hours in the twenty-four.

Had F, in the preceding example, been taken equal to 100 lbs. to the square inch, answering to the case of a high pressure engine, we should have deduced $P = 282\frac{1}{2}$ horses, the velocity of the engine being as before.

In the preceding rule, however, we have supposed V the velocity with which the piston travels, to be such that the performance of the engine will be the greatest, or the power P, thus obtained, to be the *maximum* power of the engine, answering to the given pressure. Whether the powers assigned in the preceding examples are the maximum powers of the engine, answering to the respective pressures of 10 lbs. and 100 lbs. per square inch, will be shown in the subsequent part of this inquiry.

It is usual with engine makers, for the apportionment of *low pressure* engines, to calculate the velocity of the piston as answering to the maximum performance of the engine at 200 feet per minute, the same that is ordinarily assigned for the speed of a *horse* when tracking to the best advantage.

In rating the *high pressure* steam engine, the efficient force is commonly estimated at 100 lbs. per square inch, or the pressure on the safety valve at 150 lbs. per square inch, one-third being subducted for the loss by friction, &c. With this pressure the maximum velocity is calculated at about 320 feet per minute.

The question under consideration, however, being general, or *not limited to any particular* pressure, we shall, therefore, inquire the value of V, the proper velocity with which the engine should move, whatever may be the pressure, as also F, *the efficient force or load* the engine should be charged with to produce it.

It is known that the velocity with which a fluid rushes into a *vacuum*, is equal to that which a heavy body would acquire in falling through a height equal to the *head of pressure*.

To find the velocity, therefore, with which steam, say at the temperature of 212°, would rush into a vacuum, we have, by experiments, the weight of a cubic foot of steam at this temperature equal to 253 grains. Hence, as 480×1000 grains : 1728 cubic inches : : 253 grains : .9107 cubic inches = to the bulk of water in a cubic foot of steam at the temperature of 212°, which is very near what it in common is assumed to be, viz. *one cubic inch.* Again, as 1728 : .9107 : : 1000 the specific gravity of water : 5.27 the specific gravity of steam.

The force of steam at the temperature we have assumed being known to equal that of the common atmospheric pressure, or 30 inches of the barometer, taking, therefore, 13600 as the specific gravity of quicksilver, by the following analogy, we shall have 5.27 : 13600 : : 30 inches : 77419 inches, or $6451\frac{1}{2}$ feet, the *head of pressure* corresponding to the steam, when its force is supposed just equal to that of the common atmosphere.

The velocity that would be acquired by a heavy body in falling through this height, is readily found from the dynamical relation $V = 2\sqrt{gs}$, where V denotes the velocity, s the space fallen through, and $g = 16\frac{1}{12}$ feet the force of gravity. Substituting $6451\frac{1}{2}$ for s. in this expression, we shall find $V = 2\sqrt{gs} = 644$ feet per second, the *velocity with which the steam would rush into a vacuum.*

Now since the density of steam must be as the pressure, let D

denote the density (or pressure) of steam at any temperature, and H the corresponding head of pressure.

Assume R, equal to the density of any medium into which we shall now suppose the steam to rush. Then it is obvious that the steam having the density D, when opposed by the medium, the density of which is R, will have the same velocity as though it rushed into a vacuum, with a pressure or density equal to D — R.

To find the head of pressure corresponding to this density, we have by analogy $D : D - R :: H : H\left(\frac{D-R}{D}\right)$ = to the head of pressure, or the height a body must fall to acquire a velocity equal to that with which the steam would rush into the medium.

The spaces described by falling bodies, being proportional to the squares of the velocities. If, now, v be put to represent the velocity with which steam (when its pressure is equal to that of the common atmosphere) rushes into a vacuum, or 644 feet per second, and h, its corresponding head of pressure, or 6451½ feet. Then V being put for the velocity with which steam, having the density equal D — R, would rush into a vacuum, we shall have by the above proportion $h : H\left(\frac{D-R}{D}\right) :: v^2 : V^2$. From whence it follows that $V = v\sqrt{\frac{H}{h}\left(\frac{D-R}{D}\right)}$ which is also equal to the velocity in feet per second, with which steam, having the density or pressure D, would rush into a medium, the density (or resistance) of which we assumed equal R.

In order to apply the above expression, for finding the velocity with which steam of any density, passes into the cylinder of a steam engine, or the velocity with which the piston is urged, it is obvious, supposing the density of the steam, and, consequently, the motion of the piston, to be uniform during the working of the engine, that R must be taken equal to the *total resistance* which the preponderating pressure of the steam has to overcome, that is, R may represent the load, friction, &c. of the engine.

The foregoing expression for the velocity relates to that of steam passing through a simple aperture; the velocity with which the piston moves, therefore, will be to the velocity with which the steam rushes through the steam pipe, or *openings*, as the area of the opening is to the area of the piston. Put O = to the area of the opening, and A = to the area of the piston, then the velocity of the piston will be expressed by $\frac{O}{A} \times v\sqrt{\frac{H}{h}\left(\frac{D-R}{D}\right)}$ it is obvious that the greatest velocity with which the piston may move, will be when R = o and the velocity in this case would become $\frac{O}{A} \times v\sqrt{\frac{H}{h}}$. Now it is established in dynamics, that when the velocity with which any engine works is *one-third* of the *greatest velocity* with which it is

capable of working, then will the work done be *a maximum*, or the greatest possible.

Hence it follows that the velocity with which the piston should move in order that the performance of the engine may be the greatest, or the value of V answering in the formula for the power of an engine is $V = \frac{1}{3} \times \frac{O}{A} \times v \sqrt{\frac{H}{h}}$. As the pressure of steam employed in working an engine is usually estimated by the number of atmospheres, let n express the ratio between the common atmospheric pressure and the pressure D, then we shall have the head of pressure $H = nh$ and, consequently, $V = \frac{O}{A} \times \frac{1}{3} v \sqrt{n}$ the velocity with which the piston should travel per second to produce the greatest effect.

In uniform motions, the force being as the squares of the efficient velocity, we have D, the force answering to the least velocity, to D — R, the force answering to the velocity when the effect of the engine is a maximum, as $(1)^2$ is to $\left(\frac{2}{3},\right)^2$ whence $D - R = \frac{4}{9} D$ or $R = \frac{5}{9} D$. At the starting of a steam engine it is known, that when the pressure on the piston preponderates, the engine moves with an accelerated motion, and continues so to move, until the action of the steam upon the piston has become so far diminished, by the increased velocity of the engine, that the power and resistance become equal. Hence we may consider D — R either as the effective force of the steam, or the load, &c. to which it is a counterpoise.

Let the effective force of the steam in a low pressure engine be taken at 10 lbs. per square inch, as in the former example; and suppose O : A :: 1 : 50, which is near the usual proportion; then the velocity of the piston when the effect of the engine is a maximum, will be $V = \frac{O}{A} \times \frac{1}{3} v \sqrt{n} = \frac{1}{50} \times \frac{1}{3} \times 644 \times \sqrt{\frac{10}{15}} = 3.36$ feet per second on 201¼ feet per minute.

Again, suppose the effective force of steam with which a high pressure engine is to work is equal to 60 lbs. per square inch; here $n = 4$, and supposing $\frac{O}{A}$ to be as before, we should have $V = \frac{1}{50} \times \frac{1}{3} \times 644 \times 2 = 8.5$ feet per second, or 510 feet per minute, which would be at the rate nearly of 6 miles per hour.

Let $n = \frac{100}{15}$, or, that the engine works with an effective force equal to 100 lbs. per square inch, then $V = \frac{1}{50} \times \frac{1}{3} \times 644 \times \sqrt{\frac{100}{15}}$ = 11 feet per second, or 660 feet per minute. Hence 100 lbs. × 660 = 66000 lbs. the momentum per square inch on the area of the piston.

In a former example we supposed an engine having the pressure

on the safety valve equal to 150 lbs. per square inch, to work at the rate of 200 feet per minute only; hence putting $\sqrt{\frac{D-R}{D}} = \frac{200}{660}$ we shall find R nearly equal to $\frac{10}{11}$ D, and, consequently, we shall have answering to this case, 133 lbs. $\times$ 200 = 26600 lbs., the momentum per square inch on the area of the piston, which is nearly $\frac{1}{4}$d less than when the engine carried a less load with a greater velocity. This comparison may suffice to show the advantage in attending to the proper adjustment of the load.

The method of finding the maximum of variable quantities being particularly interesting and useful, in many questions relating to mechanics, the following will be found useful to those who may be unacquainted with the fluxional or differential calculus.

Let a, denote any constant quantity, and x being supposed to vary; then when $x \times \overline{a-x}$ becomes a maximum, we shall have $x = \overline{a-x}$ or $x = \frac{a}{2}$.

This proposition may be readily demonstrated by supposing a to represent the diameter of a semicircle, and x and $a-x$ the segments of this diameter formed by a line drawn from the circumference perpendicular on the diameter, for it is known that the product of the segments is always equal to the square of the perpendicular, and this is the greatest when it divides the diameter into two equal parts. From this it also follows, that $x \times \overline{a-x} \times \overline{a-x}$ or $x \times \overline{a-x}^2$ will be a maximum when $x = \frac{1}{2}(a-x)$ and consequently $x = \frac{a}{3}$.

When $x \times \overline{a-x} \times \overline{a-x} \times \overline{a-x}$ or $x \times \overline{a-x}^3$ becomes a maximum, then $x = \frac{1}{3}(a-x)$ or $x = \frac{a}{4}$. And in general when $x \times \overline{a-x}^n$ becomes a maximum, then $x = \frac{1}{n}(a-x)$ or $x = \frac{a}{n+1}$. If, for example, W denotes the absolute effort of any moving force, when it has no velocity; and suppose it not capable of any effort when the velocity is a; let f be the effort answering to the velocity u; then the action being supposed constant, it will vary as the square of the efficient velocity, hence $W : f :: (a-o)^2 : (a-u)^2$ and, consequently, $f = \frac{W}{a^2} \times \overline{a-u^2}$. The momentum of the force will be $fu = \frac{W}{a^2} \times (u \times \overline{a-u^2})$ which is obviously a maximum when $u \times \overline{a-u^2}$ is the greatest, the quantities, W and a, being

considered invariable. From what has already been shown, $u \times \sqrt{a - u^2}$ will be a maximum, when $u = \frac{1}{2}(a - u)$ or $u = \frac{a}{3}$. This is the theorem that we before alluded to, viz., that when the velocity with which any engine works is one-third of the greatest velocity with which it is capable of working, then will the work done be the greatest possible.

In this conclusion, however, it must be understood that the quantity of weight only is considered, no regard being paid to the variations of friction arising from the motions of the weight.

Let D, as before, express the force or pressure of steam, and put $1 : m$ as any given weight on the piston, is to the resistance which would arise from the friction of this weight, when the engine worked with a given velocity, a.

From the construction of the steam engine, it is obvious, that when the engine works without any load, the resistance which arises from weight must be comparatively small; let it be assumed, therefore, equal to unity per square inch on the piston when the velocity is a and pressure D, then $a = \frac{O}{A} \times v \sqrt{\frac{H}{h}\left(\frac{D - m + 1}{D}\right)}$ and a, will express the greatest velocity with which the engine is capable of working.

Let u, denote the velocity of the piston, when loaded with a weight, L, the motion of the engine being uniform; then supposing the friction to be always in the compound ratio of the weight and velocity, the friction arising from the load when the velocity is u, will be $\frac{mLu}{a}$, and that from the parts of the engine will be $\frac{mu}{a}$.

Hence, putting W, equal to the weight that would completely stop the motion of the engine, we shall have $\frac{W \times \sqrt{a - u^2}}{a^2}$ equal to the power or action of the engine.

Now when the motion of the engine becomes uniform, the action and resistance become equal, consequently, $\frac{W \times \sqrt{a - u^2}}{a^2} = L + 1 + \frac{mLu}{a} + \frac{mu}{a}$ from whence we obtain $L = \frac{W}{a} \times \frac{\sqrt{a - u^2}}{a + mu} - 1$ and when the momentum of the load becomes a maximum, the velocity, u, will be found by resolving the following equation: $2mu^3 + (3a - 2am)u^2 - 4a^2u + a^3 = 1$.

If now we suppose the friction, m, to be constant, or not *increased by the augmentation of velocity*, and rW, to represent the resistance of the engine when operating without a load; then $\frac{W \times \sqrt{a - u^2}}{a^2} = L + mL + rW$. and consequently, $L = \frac{W}{a^2 + ma^2} \times (\sqrt{a - u^2} -$

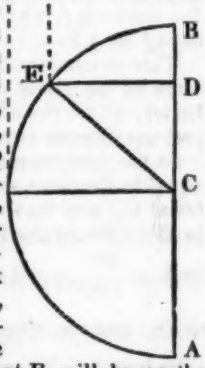
ra^2). When the momentum of the load, L*u*, becomes a maximum, we shall find the velocity $u = \frac{a}{3} \times (2 - \sqrt{3\,r + 1})$.

It is obvious that *r* W, may be taken to express both the loss of power from the *weight and friction of the engine*, and also that which arises from the nature of *crank motion*. Before we give an example in illustration of the preceding rules, it may be well to say a word or two with regard to the crank.

In a paper formerly presented to this meeting, in answer to the abstract question, "Whether the crank involved a loss of power," I endeavoured to show the affirmative, by simply calculating the effort of the crank at several points in its revolution, and comparing it with the power or energy applied at the same places.

As it is important in computing the power of a reciprocating steam engine, that due allowance should be made for the loss sustained from the application of the crank in its construction, we shall again revert to the subject.

Let AB, in the adjoined figure, represent the diameter of the circle described by the crank; then will AB, also, be the length of a single stroke of the engine, and if F be supposed equal to the effective force on the area of the piston, then F × AB, will be the momentum, or weight, the engine could raise, supposing no crank to intervene.



Suppose, now, in the application of the crank, the mechanical contrivance is such, that the *connecting rod* acts on the crank CE, always parallel to AB, (*to the piston rod*) then when the crank is at *right angles* to AB, or the connecting rod, the *whole energy* of the power, F, will be effectual in turning the crank. The effort of the power to turn the crank at any other point, as at E, will be as the effective lever DE, hence as CK : DE :: F : $\frac{F \times DE}{CK}$ = to the effort of the crank at the point E. And it is easy to see, that, as the line DE, in a single stroke of the engine, would describe the semicircular area AKEB, the *sum of all the efforts of the crank* will be $\frac{F}{CK} \times$ *area of semicircle.*

Hence, putting AB = the diameter of the circle = 1, then CK = the length of the crank = $\frac{1}{2}$, and the area of the semicircle AKEB = $\frac{.7854}{2}$. Consequently F × AB will be equal to F, and the sum of all the efforts of the crank will become 2 F × $\frac{.7854}{2}$ equal to F × .7854. From whence it follows that F : F × .7854 :: 1 :

.7854. And we shall have the loss of power from the crank equal to 1 — .7854 equal to .2146, or $\frac{1}{5}$th, nearly.

In an engine working without a beam, where the connecting rod passes immediately from the cross head to the crank of the *fly wheel*, the proportion between the rod and crank being as 6 to 1, the loss will be found equal to $\frac{3}{10}$ths, nearly. And in the *lever beam construction*, particularly when the *stroke is long and beam short*, considering both crank and parallel motion, the loss in transmitting the power from the piston to the fly wheel, will be still greater.

In the above demonstration we have supposed the force, F, acting on the piston, to remain constant during the stroke. It is known, however, that as the velocity of the piston is continually accelerated from nothing at the top and bottom of the cylinder, to its greatest velocity at or near the middle, resembling in this respect the oscillations of a pendulum: and because the force varies as the square of the relative velocity of the steam and engine; if we suppose the force on the piston to be F, when the engine has no velocity, as at the top or bottom of the cylinder, and that the force on the piston is *f*, when the relative velocity is $(1 - \frac{1}{3})$ or $\frac{2}{3}$, we shall have $f = \frac{4}{9}$ F.

This circumstance has induced some persons to infer, that, as the force on the piston diminishes as it approaches the middle of the cylinder, whilst the effort of the crank at the same time increases, a just equilibrium is maintained, and hence no power lost.

In the demonstration that has been given, let F, now, be taken equal to the force on the piston when at the middle of the cylinder, (as at C,) and that when the piston is at D, the force has increased to *d*F. When the force is constant, the effort of the crank at E, will be $F \times \frac{DE}{CK}$, and it is evident, if the force on the piston has increased to *d*F, that the effort of the crank will become $dF \times \frac{DE}{CK}$, hence the ratio between the power and the effect will be the same, whether the power is constant or variable.

The comparative advantage between engines with long and short cylinders may be readily inferred from the above illustration of crank motion.

We shall now exemplify the preceding observations, by supposing the following case.

It is intended to work a high pressure steam engine, with a force per square inch on the safety valve equal to 150 pounds, the area of the piston being 50 square inches, and the loss from crank motion equal $\frac{3}{10}$ths of the power. It is found by trial that a pressure equal to *three pounds* per square inch on the piston, is amply sufficient to overcome the weight and friction of the engine when unloaded, or that this pressure will start the engine when the piston hangs midway between the centres. Required the velocity, load, and power of the engine when operating to the greatest advantage.

Friction being supposed constant, we shall have *a*, the utmost ve-

locity with which the engine is capable of working, $a = \frac{O}{A} \times v \sqrt{\frac{n \times (D - rW)}{D}}$ where $\frac{O}{A} = \frac{1}{50}$, as formerly, $v = 644$ feet, and it is obvious that D, the effective force of the steam on the piston, is equal W, the weight that would stop the engine.

The resistance of the engine being 3 pounds per square inch, or $\frac{1}{50}$ths of the power, we have $r = \frac{3}{10} + \frac{1}{50} = \frac{32}{100}$, whence $D = W =$ 150 lbs. $D - rW = 102$ pounds, and the ratio between the common atmospheric pressure and the active pressure of the steam, equal $n = \frac{102}{15}$.

These values substituted in the above formula, will give $a = 30$ feet per second, the velocity with which the engine would run without a load.

When the engine is loaded the performance will be a maximum when its velocity $u = \frac{a}{3} \times (2 - \sqrt{3r + 1}) = \frac{30}{3} \times (2 - \sqrt{3 \times \frac{32}{100} + 1} = 6$ feet per second, or 360 feet per minute.

From experiments by Coulomb and others, the friction of iron gudgeons working in brasses, was about $\frac{1}{6}$th of the weight, and it was also determined that this friction was very little, if any, increased by an augmentation of the velocity.

Hence, from the foregoing expression for the load, we have $L = \frac{W}{a^2 + ma^2} \times (\overline{a - u}^2 - ra^2,)$ whence, by substituting 150 for W, 30 for a, 6 for u, $\frac{32}{100}$ for r, and $\frac{1}{6}$ for m, we shall obtain $L = \frac{144}{525}$ W = 41 pounds per square inch on the area of the piston; the load the engine may carry, independent of the weight and friction of the machine.

The momentum of the load Lu, per minute, when the engine performs to the greatest advantage, will be $41 \times 360 = 14760$ lbs. per square inch, and multiplying by the area of the piston, 50, we have 738000 lbs. the whole momentum of the engine per minute.

Assuming the standard of horse power equal to 32,000 lbs. raised 1 foot high per minute, the power of the engine will be equal to 23 horses.

All of which is respectfully submitted, by yours, &c.

CHARLES POTTS.

Philadelphia, November 19, 1829.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Hints Respecting the Manufacture of Indigo in the manner practised in Bengal.

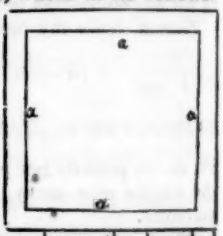
The following hints are extracted from a letter written by a gentleman in Philadelphia, in reply to inquiries made upon the subject to which it refers, by a person about to engage in the indigo manufacture.

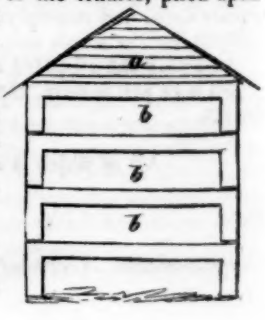
"The book to which you refer, contains nothing more than a general notice of the practice pursued in India, in the making of indigo, none of those specialities required by one who wishes practical information is to be found in it; but, by a remarkable coincidence your letter came to hand just at the time the subject of the Bengal mode of procedure was treated of in the Journal of the Franklin Institute. I send you the numbers for October and November, 1829, containing the article.

"Your inquiries respecting presses, your observations on the manufacture, and the information contained in the Journal, have conspired, with the dull weather, and set my head to work in making indigo, and I now send you the result of my cogitations, upon the value of which you will place your own estimate.

"The drying, I see, is an important part of the process, and this, I apprehend, may be much simplified, and all the baneful effects of bad weather guarded against.

"The plan I would recommend, is, to dry the indigo in the same way in which the glue makers dry that article, which is as follows. Square frames are made of inch boards, cut into strips about 5 inches wide, as *a*, *a*, *a*, *a*. On each corner a block of wood is fixed, the four serving as feet to support the frame; these may be of such height and thickness as experience may prove to be best adapted to the intended purposes of support, and height enough to admit a free circulation of air. These are to be placed upon each other, as represented in the annexed diagram, where *a* shows the boarded end of a moveable roof, and *b*, *b*, *b*, three of the frames, piled upon each other, and kept separated by the feet at their corners, the roof, also, being furnished with similar feet; the whole may be readily separated, spread out, and completely exposed, whenever the weather is favourable. There may also be moveable sides, made either in the manner of weather boarding, or of canvass, as may be found most convenient.





"The drying of the indigo upon boards, appears to me to be a very injudicious mode, as, in this case, evaporation takes

place from the upper surface only, the moisture absorbed by the boards being hardly worth mentioning. The frames which I have described, should have netting strained over them, or, perhaps, coarse canvass; this, undoubtedly, would accelerate the drying one-half.

"In case of exposure to injury from flies, in wet and damp weather, the pile of frames may be elevated so as to place a chafing-dish of burning charcoal beneath them; the heated air from this, if the sides are properly enclosed, will drive off the flies, and at the same time, from its constant and rapid ascent, accelerate the process of drying. I am not informed respecting the effect of the direct rays of the sun, or the particular influence of carbonic acid upon indigo, but am fully impressed with the idea, that the procedure which I have described, will be found to be a real improvement, and enable a few hands to manage the drying of a large quantity.

"The frame into which the indigo pulp, or batter, is put, for the purpose of pressing, should have numerous small holes in it; these holes should open into grooves under the bottom of the frame, or box; this would make every hole efficient in allowing the escape of moisture.

"The material of which the cloth which forms the lining should be made, will be learned by experience; probably either linen, cotton, or wool, may answer; I am inclined to the opinion that one of cotton in contact with the indigo, surrounded by another of wool, will be most effectual.

"With respect to the improvement of your mill, I foresaw when I pressed you to visit mine, that to this you must come at last. A millwright and miller can, I dare say, be obtained to suit your purpose; the medium wages of such a one, here, would be about $300 a year; what one can be hired for to dwell in your part of the country, will depend upon accidental circumstances; his good qualities, and his disposition to visit distant parts, will be influential items. I know that the producers of sugar, indigo, and cochineal, the diggers of silver, and the washers of gold, will be a set of poor miserable devils, if they depend for their supply of food and clothing upon any country except their own; and even then, should they resort to paper money, they, with it, will increase crime, and diffuse poverty."

R.

Account of some Experiments upon Caoutchouc, or Indian Rubber; recently instituted at Philadelphia, by John K. Mitchel, M. D. Lecturer on Chemistry, &c.

We have received from the above named gentleman, some account of his experiments on the distension and inflation of Caoutchouc; he has also read a paper upon the subject, before the American Philosophical Society, and several notices respecting them have likewise appeared in the daily journals. We shall probably hereafter lay some

further details before our readers. The communication referred to, contains the following information:—

Mode of making Gum Elastic into bags, sheets, &c.

Soak the gum elastic in sulphuric ether until soft and almost inelastic, which, in good ether, will take from 10 to 24 hours. Then, if it is a plate, cut it with a wet knife, or parallel knives, into such sections, or sheets, or shapes, as may be desired, and suffer them to dry; or, if a bag, apply a pipe, or stop cock, and inflate with the mouth, rapidly if the bag should expand equally, more slowly, and with occasional pauses, if unequally. By such means a bag may be made so thin as to become transparent, and light enough to ascend when filled with hydrogen. By graduating the extent of inflation, sheet caoutchouc, of any given thickness is produced. If for blowpipes, or other purposes, for which it is desirable that the bags should possess contractility, let them be inflated to the desired size, and after an hour, let out the air. Ever afterwards they will suffer as great a degree of extension, and again contract. If permanent sheets are wanted, the inflated bags are to be hung up, until dry, after which no sensible contraction will ensue.

Bags softened by ether may be readily stretched by hand, over lasts, hat blocks, or other moulds, so as to assume the shape desired, and may, therefore, be appled to a variety of useful purposes. In the form of straps, and twisted strings, its elasticity offers many useful applications. It may be made to assume the form of a tube, to connect parts of chemical and other philosophical apparatus with each other; it may be employed as covers for bottles, corks, &c.; and indeed wherever the passage of steam, or air, is to be prevented. It is also susceptible of numerous applications in medicine and surgery.

Dr. Mitchell has extended a bag which was about the size of a skinned English walnut, and which weighed three drachms and a half, until its diameters were 15 and 13½ inches respectively.—Larger bags have been made to attain a diameter of six feet; one of these, when filled with hydrogen, escaped, and was found at the distance of 130 miles from the city. Balloons so formed have been exhibited before the several classes attending chemical lectures in Philadelphia.

The discovery, by the same gentleman, that essential oil of sassafras will soften caoutchouc so that it may be applied to any surface with a brush, promises, also, much utility. When dry, it becomes again simple caoutchouc, with all its original elasticity. If it be applied on a plate of glass, dried, and then immersed in cold water, the sheet may be peeled off. It has been spread upon paper, and after becoming dry, the whole immersed in water, when on stretching it the paper would, of course, separate into fragments, between which the gum elastic might be stretched so as to separate them to the distance of a quarter of an inch, without itself giving way, notwithstanding its tenuity. Such a varnish will never crack, one of its essential attributes being elasticity.

By turning to page 34, Vol. I, of this Journal, for 1826, a mode

will be found of distending caoutchouc after heating it in water. The distension in this case was not permanent; its application was to the blow-pipe only.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A sketch of the History and Properties of Caoutchouc. By CHARLES DAVIS, M. D.

THE increasing applications of caoutchouc, or Indian rubber, as it is commonly called, to useful purposes, render it an object of such general interest, that a short account of its properties, and the sources from whence it is derived, may not prove unacceptable to your readers.

This substance was first introduced into Europe about the beginning of the last century. Nothing definite was known with regard to its origin. Some philosophers supposed it to be an artificial production. In 1735 the Academy of Sciences, in Paris, sent a company of gentlemen to South America, for the purpose of measuring a degree of the meridian; in the following year, one of them, M. Condamine presented a memoir to the Academy, in which he states, that caoutchouc is procured from a tree growing in the province of Esmeraldas, in Brazil. When incisions are made into the bark of this tree, a milky fluid exudes, which, when exposed to the air, concretes and forms caoutchouc. The same tree was afterwards found in Cayenne, and on the banks of the Maragnon. It has since been discovered, that various plants which grow in warm climates yield caoutchouc. A considerable quantity of it was procured, by Mr. Howison, from a climbing plant, which is found in several of the East India islands. In Prince of Wales' Island, a party of soldiers were employed in clearing a passage through a forest; they used their sabres to cut away the underwood, and were surprised to find the blades covered with a substance which had all the characteristics of caoutchouc.—The plant from which the gum exuded, was a thick vine: when deep incisions were made into the bark, a fluid was obtained which had the consistence of cream; when this fluid was spread upon any surface, it concreted into a thin stratum of caoutchouc—Mr. Howison made moulds of wax, in the form of boots, gloves and bottles; the fresh juice of the plant was spread upon these moulds, and suffered to dry; in about ten minutes a second coating was applied; it required about thirty coats to form a boot of the proper thickness. When the boots and gloves were finished, they were removed from the moulds by turning them over at the tops, and stripping them off, as a glove is drawn off from the arm. Gloves and stockings, made of cotton yarn, were drawn upon the moulds, and then immersed in vessels containing the fluid gum. When taken out, and exposed to the air, an envelope was formed upon every fibre of the cotton, so that for gloves, or stockings, no additional coating was necessary. Pieces of strong canvass, coated with the gum, were formed into

soles, heels and straps; these, when dry, were moistened on the surface with the recent juice, and applied to the stockings, to which they became firmly agglutinated; and thus boots were formed, which presented a very neat appearance. By spreading the liquid on the surface of nankeen, Mr. Howison formed a cloth which was very flexible, and perfectly impervious to water. He recommends this cloth as a suitable material for garments; no sewing would be required; the edges of the different pieces being placed in contact, and wet with the recent juice, would adhere, and the article would be ready for use.*

From these facts it is obvious, that if caoutchouc could be procured in large quantities in a fluid state, it might be applied to many important purposes. It, therefore, becomes an object to devise some means by which the solid gum, as it occurs in commerce, could be rendered fluid, or could be wrought into the different forms best adapted to various uses. From a variety of experiments by different individuals, the following results have been obtained.

When heated in close vessels, to a high temperature, caoutchouc melts into a black viscid substance resembling tar, which does not concrete on cooling. When this fluid is incorporated with oil of turpentine, it forms a tough varnish, which has been used to defend the surfaces of engraved steel dies, plates, &c. from the action of the air and moisture. The varnish may be removed by a brush charged with warm oil of turpentine.

Boiling water softens caoutchouc, but does not dissolve it; two pieces which have been boiled for a long time, when strongly pressed together, form a permanent adhesion to each other. When softened in this manner, it may be drawn out into thin lamina resembling gold beater's skin. An artist named Matthias More, conceived the idea of substituting transparent slips of caoutchouc for the glass slides on which the figures are painted in magic lanterns. He purposed to paint, or print, the figures on a long strip of caoutchouc; this was to be wound on and off a cylinder, thus bringing the figures successively before the lens. By soaking the caoutchouc for many hours in warm water, he succeeded in stretching it to a very great extent, and in rendering it exceedingly thin and transparent. Bottles of this substance were inflated by means of a pair of bellows—balloons were thus formed, which, when filled with hydrogen gas, ascended into the atmosphere.†

Gum elastic bags may be dilated, without previously softening them, by forcing in air with a condensing pump.

When caoutchouc is boiled in the expressed vegetable oils, in wax, butter, or animal oil, it is dissolved, and combining with these substances forms viscid inelastic compounds. Ether, naptha, and cajeput oil, appear to be the only solvents from which it can be separated unchanged. When the ethereal solution is poured upon water, it spreads equally over the surface, the ether rapidly evaporates, leaving a thin film of caoutchouc, which retains all its characteristic properties. The rapidity with which the ether evaporates renders

* Philosophical Magazine, vol. 6. † Ibid. 59.

it very difficult to apply this solution to any practical uses; this, together with the expensiveness of the solvent, has hitherto rendered its applications extremely limited.

"In order to form tubes of caoutchouc, the best method is to cut a bottle of this substance into a long single slip, and soak it for half an hour or an hour in ether: by this means it will become soft and tenacious, and if wound dexterously on a greased mould, bringing the edges in contact with each other at every turn, and giving the whole a moderate and equal pressure by binding it with a tape wound in the same direction as the caoutchouc, a very effectual union will be produced."* Dr. Roxburg, to whom we are indebted for a botanical description of the East Indian vine from which the caoutchouc is obtained, dissolved this substance in cajeput oil. When alcohol is added to this solution, the caoutchouc is separated from the oil, and floats upon the surface in a semi fluid state; when exposed to the air it becomes firm and retains its elasticity perfectly.

"Mr. T. Hancock has succeeded, by a process which he has not published, in working caoutchouc with great facility and readiness. It is cast into large ingots or cakes, and being cut with a wet knife into leaves or sheets, about one-eighth or one-tenth of an inch in thickness, can then be applied to almost any purpose to which the properties of the material render it fit. The caoutchouc thus prepared is more flexible and adhesive than that which is found in the shops, and is worked with singular facility. Recent sections made with a sharp knife, or scissors, when brought together and pressed, adhere so firmly as to resist rupture as strongly as any other part; so that if two sheets be laid together and cut round, the mere act of cutting joins the edges, and a little pressure on them makes a perfect bag of one piece of substance. The adhesion in those parts where it is not required is entirely prevented by rubbing them with a little flour. Bags made of this substance have been expanded by having air forced into them until the caoutchouc was quite transparent, and when expanded by hydrogen they were so light as to form balloons with considerable ascending power, but the hydrogen gradually escaped, perhaps through the pores of this thin film of caoutchouc."† Dr. John K. Mitchell has lately formed large balloons of caoutchouc, by softening the bottles in ether, and afterwards inflating them; one of these balloons, filled with hydrogen gas, rose into the air, and fell, it is said, at the distance of 130 miles from the place of ascension.

The elasticity and tenacity of caoutchouc, its power of resisting the action of most chemical agents, and the recent improvements in working it, promise to render its applications in the arts much more extensive than they have hitherto been. The process for softening the caoutchouc, is, to leave the *bag* 10 or 12 hours in *common ether*, and then to blow it out to the desired thinness, by fastening into the aperture a tube and stop cock.

Philadelphia, January 18, 1830.

* Rees' Cyclopædia, art. Caoutchouc. † Quarterly Journal, vol. 17.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1829.

With Remarks and Exemplifications, by the Editor.

1. For a *Self-moving Cradle;* Anthony Buchenberger, New York, November 3.

A common swinging cradle is to be made to vibrate by a spring movement, like that of a time-piece, which is to be let into one of the uprights, and of this movement the cradle becomes the pendulum.

The claim is to "the method of working a cradle, and the adaptation of the movement above described."

In the days when cradles were as numerous as infants, and swaddling bands and chin stays were accounted necessary to preserve the juxta position of the joints, it was frequently proposed to rock the child to sleep by clock work, and we have little doubt that it has actually and repeatedly been carried into practice; at all events, the proposition of the matrons and the nurses is now to be realized, and our children are to be made to sleep against time, provided their parents consent to it. We are very apprehensive, however, that the determined departure of the moderns, from the usages of primitive times, will interfere with the patent mode of inducing sleep, and prevent its becoming a profitable concern.

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2. For an improvement in the *Manufacturing of Chandeliers, by the Crystallization of Salts* upon their frames; Franklin Ransom, Buffaloe, Erie county, New York, November 3.

By turning to page 188, of our last volume, it will be seen that a patent was granted on the 13th of June last, to F. B. Merrill, of Buffaloe, for ornamenting the skeletons of chandeliers, &c. by immersing them in a saturated solution of alum, or other salt; chandeliers so ornamented being intended as cheap substitutes for those of cut glass. The present patent is obtained for the same thing precisely, and both the inventors or discoverers reside in the same town; which of them invented, or discovered it first, or whether they discovered it originally in a chemist's laboratory or a lady's boudoir, we are not informed. Ornaments of this description were familiar objects in our boyish days, sometime far back, in the last century; although it had then been discovered that crystals would attach themselves to twigs interwoven in the form of baskets, grottoes, and pyramids, the knowledge that sticks, or wires, bent in the shape of the frame of a chandelier, was, it seems, reserved to become one of the notable improvements of the present day.

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3. For a new and useful machine for winding up clocks, called "*Ward's Self-moving Power;* Richard Ward, Waterbury, New Haven county, Connecticut, November 5.

Without attempting a critical analysis of the name, "a self-moving power," which appears to us rather incongruous, we will at once proceed to a short description of the winding apparatus intended to be applied to a clock. Air, like other bodies, is expanded by heat and contracted by cold; it is proposed to use the expansion and contraction of this fluid, by natural changes of temperature, to keep a clock perpetually wound up.

An air chest, or reservoir of the capacity of four or five gallons, it is estimated by the patentee, will be sufficient for a time-piece with a striking movement. A tube is to pass from this air chest into a small gasometer, constructed with three concentric cylinders, precisely like those used for gases by the chemist. When the air expands in the chest, it is forced through the tube, and raises the middle cylinder of the gasometer, and when it contracts the cylinder consequently falls. This cylinder is so suspended that a cord, or catgut, which passes over a pulley, turns a drum or barrel, and winds the clock, whether ascending or descending. The particular modes of effecting this, described by the patentee, we shall not at present detail; those conversant with machinery will be at no loss in perceiving how this may be done.

That a delicately made time-piece may be wound up by the expansion and contraction of fluids or solids from natural changes of temperature, is an admitted fact. In our article on Perpetual Motion, vol. 2, new series, page 326, we have made the following remarks upon the subject of the application of some of the moving objects in nature. "Some of these may be employed to keep clocks and other engines wound up, so that their action shall be continued. The contractions and expansions of a long bar of metal, from changing temperature, the rise and fall of mercury in the barometer, the perpetual current of rivers, the flux and reflux of the tide, regular and irregular winds, and drafts or currents of air, the hygrometric changes in certain substances, are of the kind intended; the employment of some of them is familiar, and the possibility of using the whole of them, as well as some others which have not been enumerated, will be evident to most of our readers."

The possibility, and eligibility of a thing, are, however, very distinct questions; in machines for which patents are obtained, and which, of course, are expected to yield a profit to the patentee, the latter is the only point of importance; we apprehend that the present plan, like many of its predecessors, will fail to recommend itself by its actual utility, so as to repay the patentee for his expenditures of time and money.

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4. For a *Churning Machine;* Horace Saxton, Paris, Oneida county, New York, November 6.

This is a churn with a rotary dasher turned with a wheel and pinion, by means of a crank. "The body of the churn to be made of potter's clay and burned, which improvement only is claimed as his invention."

It is to be hoped that those potters who have for many years been in the habit of forming their clay into churns, will do justice to the claims of the *inventor.*

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5. For *Improvements in Steam Engines;* Mellen Battle, Albany, New York, November 6.

In the specification it is stated, that "the objects of this improvement, are, to lessen the quantity of fuel, to make the generator of steam more durable, less subject to explosion, more powerful, and with a less quantity of water."

These are important objects, and, in a letter which accompanies the application for a patent, it is stated, that there is a clear saving of fuel of *at least* two thirds. As we are of opinion that it is not possible, in the nature of things, to approach so large a saving in the fuel employed for the generation of steam, we are not prepared by such a declaration to find the claim founded upon correct principles, or well tested experiments.

The improvement is said to consist of four distinct branches.

1st. A new combination of steam pipes, or generators, with the common high or low pressure boiler.

2nd. Placing a reservoir between the high and low pressure engines, and connecting them with one shaft.

3d. The formation of a generating supply pipe.

4th. The formation of a generator in the smoke pipe.

We cannot enter into particulars, but will observe that tubes, charged with water, or steam, are to be used in conjunction with the ordinary boiler; that it is proposed to use steam twice; in one cylinder as high, and in another as low steam, as in Wolfe's engine, but in a manner somewhat modified; that pipes containing steam be placed within the smoke pipe, or chimney, that the contained steam may be rarified by the heated air which is escaping.

This last proposition is at variance with what is now considered as well established by experience, and as sound philosophy; that little or no advantage is gained by heating steam in this manner, as whilst it is thus heated, it also becomes less dense; this error of heating ready formed steam, appears to us to prevail in some other parts of the proposed alterations. We have not taken time, however, to give that critical attention to *all* the proposed alterations which would justify a decisive expression of our opinions respecting them, nor have we room, here, to spare for the investigation. The claim, of course, consists of the four enumerated improvements.

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6. For an improved *Cooking Stove;* Joseph Hurd, jun. Boston, Massachusetts, November 10.

"This improvement consists in the combination of a furnace and oven, partially, or wholly, surrounded by polished tin, or other metal, as reflectors; and a boiler which is set upon the oven, and is so constructed that it receives into a cavity, or chamber, at its bottom, the

smoke and hot air from the furnace, which previously passes around the oven."

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7. For a *Furnace with Reflectors;* Joseph Hurd, jun. Boston, Massachusetts, November 10.

"This improvement consists principally in the application of tin, or other polished metal, to serve as a reflector, around, or partially around the furnace, by means of which a great portion of that heat is saved, and applied particularly to objects for which it is wanted, which must be lost by radiation, or absorption, when the fire is made on brick work, or in common iron stoves."

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8. For an *Oven with Reflectors;* Joseph Hurd, jun. Boston, Massachusetts, November 10.

"This improvement consists principally in the application of tin, or other polished metal, arranged around, or partially around the oven, which will reflect back upon it the heat which would otherwise be lost by radiation or absorption, according to the material made use of."

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9. For an *Improved Boiler;* Joseph Hurd, jun. Boston, Massachusetts, November 10.

"This improvement consists principally in having a chamber, or cavity, at the bottom of the boiler, which receives all the smoke and hot air from the furnace, and from which all external air is excluded. It has a flue, or pipe, through the side, to carry off the smoke into the chimney, or elsewhere."

We expect shortly to see the inventions to which the four preceding patents refer, in actual operation in this city, and are prepared to place them on the list of real improvements; at all events they appear to be founded upon correct scientific principles, and we hope that the test of experiment may show that these principles are well applied. It is probable that a full account of them will hereafter appear in the Journal.

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10. For an improvement in the *Art of Spinning Wool;* John Orndorff, Russelville, Logan county, Kentucky, November 10.

The specification of this patent extends over ten pages closely written, and principally devoted to the giving of precise dimensions of every part of the machine; this is a very common error in these instruments, which renders them needlessly long, whilst it details what may be departed from, in almost every case, without affecting either the principle or the action of a machine.

This instrument is intended as a domestic spinner, and in its general structure resembles numerous others, contrived for the same purpose; the patentee has not claimed any thing, or in any way in-

dicated the part in which his improvement is contained; of course what he intended to patent remains unknown, excepting it may be to himself.

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11. For an improvement in the *Throstle for Spinning Cotton*, applicable also to roving cotton, and to roving and spinning flax, hemp, wool and worsted, &c.; Samuel Blydenburg, New York, November 10.

The improvement here claimed, is similar to patent 13, for October, noticed at page 27, as a modification of the revolving ring originally patented by Mr. John Thorp, of Providence, Rhode Island. The specification begins by informing us that "this improvement consists in dispensing with the flyers from the spindle, and substituting in place thereof the apparatus below specified."

"That which I claim as my invention, and constituting this my improvement, is the method of *taking up*, as it is technically called, or winding up the thread upon the bobbin, as it is delivered from the rollers and twisted by the turning of the spindle and bobbin."

"This I effect by means of a small ring, which revolves round the spindle and bobbin concentrically with the same, and running loosely in the grooved edges of three or four little friction pullies or shieves, which friction pullies or shieves run, either on male centre points above and below, or on pins standing vertically, and parallel to the spindle," &c.

The greatest difficulty which an inventor has to encounter, is that of so guarding his claim as to secure to himself the *principle* of his discovery. There are so many ways in which the same principle may be varied, that it is impossible for one man to think of, or one instrument to describe them all. In one sense of the term principle, it may be claimed, and the claim sustained; that is, in the sense in which it conveys only the idea of a new mode of action, susceptible of many modifications. An abstract principle, as it exists in nature, is not the subject of a patent. How far Mr. Thorp may have secured his principle, is a point which we shall not agitate.

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12. For an improved *Shingle Machine;* Simeon Wood, Holden, Worcester county, Massachusetts, November 10.

Circular saws are to be used in this machine, as in several others which have previously been patented. The construction of the machine cannot be understood without drawings; the general arrangement, however, appears to be good, and to differ materially from either of those which we have heretofore examined.

It is proposed to use two circular saws moved by one drum, and each of these saws is to cut two shingles at the same time. The advantages stated by the patentee to result from the use of his machine, are, that "several saws may be worked in one frame. Each saw cuts, at one operation, two shingles. The carriages which contain the blocks are moved up and down by gearing. The method of setting the block is exact, and makes all the shingles of like thick-

ness, without waste of timber. The cut of the saw is with the grain of the timber, making the shingles more smooth, and less liable to decay. It saws blocks of irregular surfaces, there being no occasion of a flat side."

The points claimed as new, are, the method by which two blocks are sawed at the same time by one saw, and its cutting the timber with the grain. The construction and adaptation of vertical carriages to this purpose. The method employed for confining the block in its place, and setting it at each end, for a but and point alternately.

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13. For a churn, called the *Oval Churn;* John Oathoudt, Lebanon, Madison county, New York, November 10.

In this oval churn are two upright shafts with slats, or dashers; the slats of one passing in the spaces between those of the other. These shafts are turned in opposite directions by a wheel with cogs, or pins, on each face, working into pinions on the upper ends of the shafts.

Similar dashers, it may be recollected, were described by us long since, but they are not claimed as new, excepting by inference, in which case every part of this churn is so likewise, as we are not told in what the invention, or novelty, consists.

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14. For an improvement in the art of *Distilling the Meal of Maize, or Indian Corn;* Anthony Doolittle, Ypsilanti, Washtinaw county, Michigan Territory, November 10.

The patentee describes his particular manner of producing fermentation, which, as it is probable he may not think it for his interest, we shall not at present publish.

He states that when the fermentation is completed in the manner directed, "a beautiful limpid oil, to the amount of about half a gallon, or one pint to a bushel of corn, will be found floating on the surface of the beer, or liquor, in the tub." This is to be skimmed off, and distillation effected in the usual way, when from four to six quarts more of whiskey will be obtained from every bushel of meal, than by any process heretofore known, and of a greatly improved quality.

"Now what I claim as new, and as my own invention, is the procuring of the oil above specified by the fermentation of the meal of maize, or Indian corn, and thereby increasing the quantity and improving the quality of the spirit, or whiskey, on distillation."

We will only add, as regards the oil, that "there are more things in heaven and earth than have been dreamed of in our philosophy."

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15. For a machine for *Turning the Locks in Stove Funnel,* tin ware, or copper ware, and for forming the article; Oliver Hubbard, Claremont, Sullivan county, New Hampshire, November 12.

The workers in copper, tin, and sheet iron, know that several

different machines have been made for turning the edges, to form the grooves upon their work, and for bending the sheets into a cylindrical form. The present, as the title indicates, is an addition to this number. The drawing accompanying the specification, does not very clearly represent the machine; there are, however, two cylinders, on one of which there are plates extending from end to end, forming a groove into which the edge of the sheet is to be put, when by a slight turn it is bent over; the other edge may then be placed in the groove in the same manner, and the cylinder turned until the proper curvature is given to the sheet.

No notice is taken of any other machine, no statement made of what is new in this, and, consequently, nothing claimed.

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16. For a machine for *Riving, Jointing, and Squaring Shingles;* Parke Jones, James city county, Virginia, November 12.

For riving the buts, there is a gang of knives, or frows; six of these are represented in the drawing as connected together. These frows have in each end a hole of about an inch in diameter, through which to pass an iron bar. Between each knife there is a ring, or washer, to preserve them at the proper distance apart. With this a number of shingles are to be split out at one operation.

To dress the shingles, a strong frame, or bench, is placed horizontally. A lever ten or twelve feet long turns upon a pin at the back edge of the bench; this lever is to be moved backwards and forwards by hand. On the under side of it, and just over the middle of the bench, a knife of sufficient length, width, and thickness, is bolted. The shingle to be dressed is laid upon the bench in a suitable cavity, and the knife passed over it. By means of a treadle the shingle is then raised, turned over, and the other side dressed. Several are then to be put edgewise, side by side, into a box, under the knife, and the edges dressed. Their but ends are then passed through a mortise, and the knife in like manner passed over them.

The claim is to "the construction of the above described machine with the combination of its various parts."

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17. For *Machinery for Washing Clothes*, and all kinds of cloth, &c., and for smoothing the same; Eleazer Berry, Bethel, Windsor county, Vermont, November 12.

A frame is to be made to contain two cylinders, one over the other. The whole is to be formed so as to fit into a washing tub, or box. the upper cylinder is to bear upon the lower by means of weighted levers. The clothes are to be passed between the cylinders, which are to be turned back and forth by means of a crank. We are told that it will also serve the purpose of a mangle.

The cylinders, or rollers, with their rotary motion, for the purposes specified, constitute the claim.

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18. For an improvement in *Mills for Grinding, Washing, and Separating Gold* and Silver from ores, earth, or in whatever

state these metals may be found. Patented February 13th, 1828. Patent surrendered, and re-issued November 18th, 1829.

The amended specification of this patent is of great length, and is accompanied with six separate drawings. Should all the points claimed in the subjoined formidable list prove to be new, the patentee may be fairly set down as a great inventor, or discoverer.

"I claim as original, the manner of applying the moving power to the shaft of the mill for grinding gold ores, &c. above the runner, by means of iron bevil wheels, or a wooden trundle head and spur wheel, as by this means any number of these mills may be geared to a large horizontal spur wheel, or upon a horizontal shaft upon which bevil wheels are fixed, which may be turned by a large water wheel, or by steam power."

"2nd. The manner of constructing the bed stone to this mill."

"3d. The manner of constructing the iron bed of this mill, and its application."

"4th. The manner of placing the gudgeon in the bed."

"5th. The upright post, in the end of which is fixed the gudgeon."

"6th. The manner of placing the ink in the foot of the perpendicular shaft."

"7th. The sliding board, or regulator."

"8th. The manner of applying a moveable body to the body of the axle, so that the axle may be raised or depressed at pleasure."

"9th. The opening in the side of the shaft, communicating with the long mortise in the same, for the axle to run in."

"10th. The removal of the runner close to the body of the shaft, by which means it rolls and *slides* in a very small circle."

"11th. The long body in the mortise of the shaft, against which the axle rests."

"12th. The tube for conveying the water upon the round part of the axle within the mortise."

"I claim as original the application of the second mill, and the purposes for which it is used."

"I claim as original the wooden runner, or wood banded with iron in the manner described."

"I claim as original the third mill for grinding gold ores in water."

"I claim as original the tipping box, and the purposes for which it is used."

"I claim as original the fourth mill, and the purposes for which it is used."

On comparing the present specification with that accompanying the patent of 1828, we find so little resemblance, that we never should have suspected one to be a mere amendation of the other. When a patent is surrendered, and a new one taken for *the same thing*, it appears to us that the thing ought to be *the same*; that there should be no new claim, but, merely, a more clear exposition of what was intended to be described and claimed originally. If any thing altogether new has been devised, a patent should then be taken for this, as an improvement upon a former machine; a different course certainly renders the security of the new claim doubtful.

19. For a *Washing Machine;* Charles D. Wright, East Haddam, Connecticut, November 19.

A shaft, furnished with several cranks, works beaters, or stampers, which extend from the cranks in a sloping direction to the further end of a box, or trough, where they are to hammer the clothes until they are clean.

There is no claim.

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20. For *Faggoting and Making Anchors;* James Tucker and John Judge; Washington City, November 19.

The specification informs us that "this improvement consists in forming the faggots for the anchor of one or two flat bars instead of the square bars formerly used. The bars required to make the anchor are drawn to models, which, when completed and faggoted, form the exact shape of the component parts of the anchor, whereby consolidation only is required to render the parts ready for welding together to form the anchor. These faggots consist of bars requiring one or two to form a breadth; if of two bars of an irregular width, they are so arranged, (the broad and narrow bars being placed on each other alternately,) that the only joint through the middle of the shank becomes broken."

The claim is to the shape of the bars and the manner of faggoting them, so that they form the throat, crown, and scarphs, dispensing with the several intricate pieces requisite in forming them by the usual method of making anchors."

"The advantages derived from these improvements are as follows. 1st. The bars being placed on edge, in the directions of the strains, obviously increases the strength of the anchor. 2nd. The welds not being more than three, (as the faggoting of the shank and arms forms the throat and crown,) reduces the expense to 35 per cent. less than the common way of making anchors, in addition to the great strength it possesses over those made by the usual method."

The drawings which accompany the specification exemplify the mode pursued. Of its superiority we have no doubt, as every bar used in forming the largest anchor extends to the surface, and must, there at least, be firmly welded, whilst in the old mode it is well known that the surface frequently forms a case only for bars in the inside, which are perfectly detached from their fellows.

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21. For an improved *Stereotype Plate;* Nathan Hale, Boston, Massachusetts, November 20.

The improved plate is intended for maps, and other subjects in which drawing and lettering are combined. Blank type, quadrets, or spaces, are to be cast of the usual height of type, so that when set up they will stand even with the face of the letter. These are to be set by the compositor with the required names standing in their proper places; from this a block is to be cast in the usual way of

forming stereotype plates, when the lines of the map, or other drawing, are to be formed by the graver.

"The invention claimed as original consists of the union of the lettering and such parts of the cut as are formed by casting, with the blank parts of the same plate, having an even surface, on which other parts of the same map, or drawing, may be formed by engraving; and in an improved stereotype plate formed as herein before described."

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22. For *Manufacturing thoroughly Carbonated Steel;* Stephen Pope, New York, November 20.

The plan proposed, is, to mix together prescribed quantities of charcoal from wood, animal charcoal from leather, and horn shavings, common salt, and urine. This mixture is to be stratified in the furnace, with bars of iron; the upper stratum to be covered with sheet iron, upon which is to be placed sand to the depth of eighteen inches, to serve as a packing to the whole; the process is then to proceed in the ordinary way.

The claim is to "the fine salt, which is to be thoroughly mixed with the other ingredients."

How frequently, and how long since, salt has been used as one of the ingredients in making steel, it might be difficult to tell; we have known it used in case hardening in days long gone by, and have published more than one patent in which it was contained among the ingredients employed. In the theory of its operation we see nothing to recommend it; if, however, it be found good in practice, our theory may be sent to Coventry; upon the question of novelty, however, we have no theory, and all the facts are against the present claimant.

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23. For a *Chain Wheel;* Joseph Hines and Enoch D. M'Cord, Sandy Hill, Washington county, New York, November 20.

The patentees state, that instead of the two wrought iron chains, passing round cylinders above and below, and upon cogs to sustain the buckets placed between them, they form their buckets partly of wood, with ends of cast iron, in such a way that they form the chain by linking together, or hooking like a clasp. These are to pass over a wheel, or drum, of from two, to four and a half feet in diameter, with proper cogs, or hollows, to receive pins, or projecting pieces, which prevent the chain of buckets from slipping over. No lower drum, or cylinder, is required, the buckets being suspended from above.

"Each bucket being made separate, any number may be taken off in a short time, to avoid back water, and put on again at pleasure."

"The water may be carried over the wheel, or it may fall into the buckets on the side just above the upper shaft, or below it."

"The improvements claimed, are, the application of cast iron to form the chains. The application of each head of each bucket to form one link of the chain; and the manner of connecting the heads together. The combination of the several parts as a whole in the manner described and specified."

24. For *Propelling Boats* in the water by the application of sculling wheels, or screw propelling wheels; Benjamin Smith, Rochester, Monroe county, New York, November 20.

These paddle wheels are formed like the wheel of a smoke jack, and are to be fixed at the stern, or bow, of the boat, by means of a shaft running through their centres, and worked by any suitable power.

"What I claim as new, and as my own invention," says the patentee, "is the application of wheels of this description to propelling boats in the manner described; they never before having been used for that purpose."

Wheels of the above kind have been patented, tried, and abandoned, long since. It is one of those obvious modes of propelling which has suggested itself to hundreds of persons; could the propellers be made to run in soft clay, whilst the boat floated on water, they might screw her merrily along; when acting on a perfect fluid, the hopes of all who had calculated upon their utility have been disappointed.

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25. For an *Anthracite Coal Cooking Stove;* William Davis and R. W. Lord, New York, November 23.

The fire is made in an open grate, with the bars formed in the usual way. The ends and flue part, or throat, above the grate, are of cast iron. The grate slides in, so that the fire stands under an oven, which oven allows the heated air to circulate round it. When fuel is put on the grate, it must be drawn forward. Behind the oven is a box, forming part of the flue, with openings for boilers, &c. "The whole is mounted on scroll legs, on the inside of which, and at the bottom of the grate, are flanches supporting a sliding pan, or hearth, to receive the ashes."

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26. For a *Mucilaginous Durable Compound, as a Substitute for Oil* in the mixing of paint; Lawrence J. Vankleek, Poughkeepsie, Dutchess county, New York, November 23.

This being a recipe, the publication of which might interfere with the interests of the patentee, it is omitted.

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27. For a *Machine for Washing Clothes;* Roswell Brainerd, Haddam, Middlesex county, Connecticut, November 23.

Hammers of the construction usually employed for fulling, are placed at each end of a box, and are worked by levers. As no part is claimed, and we do not know what part of the machine is new, further description is unnecessary.

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28. For a machine for *Moulding Bricks;* John S. Hanna, Mercer county, Pennsylvania, November 23.

We are told that with this machine 144 bricks may be made in a

minute, and that about 8000 may be made in an hour: as it is to be worked by horse power, we suppose that it is intended that this number may be made by one horse. It would be difficult to describe the machine without a drawing, and that which the patentee has furnished is extremely imperfect. The clay is to be ground, or mixed, by knives fixed upon shafts running horizontally in a circular box, in a form which presents no novelty whatever, being similar to those used in potteries. The pressing machine, so far as the drawing and description can be understood, does not offer, in our view, any thing, either special or general, worthy of remark; nor has the patentee appeared to differ from us in opinion, as he has not put in any claim.

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29. For an improvement in *Spinning or Throwing Silk, Wool, Cotton, &c.;* Henry Ruggles, New York, November 24.

It will be seen by the subjoined claim, that this patent, as well as those numbered 11, in the present, and 13 in the last number of this Journal, are modifications of Mr. John Thorp's 'Ring groove spinner.' The observations formerly made upon this subject need not be here repeated.

"The particular feature of novelty in the machinery above described, which I claim as new, and of my invention, is, the combination of machinery, or parts of machinery, by which a wheel, or wheels, is made, or permitted, to travel round a spindle, on a lip or lips of metal, or other hard substance placed between the wheel and the spindle, and surrounding it, so as to permit the yarn, or hook, or axle of the wheel, to travel freely round a spindle, without touching the lip, or lips; thus effecting, or permitting a free rotary motion round a spindle without impediment, being an addition to, or improvement on, the before known throstle frame which is commonly used for spinning, being designed as a substitute for the flyers used in that machine."

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30. For a machine for *Washing, Scouring, and Fulling Cloth,* and manufacturing the same; thrashing, working hat bodies, making matting, or carpeting, of wool, fur, or other substances; Harvy Slayton, Lockport, Niagara county, New York, November 25.

This, by the title, would seem to be a sort of universal manufacturing machine, yet, judging from the drawing and description, it appears to be one of the most crude and undigested concatenations of weights, levers, wheels, and rollers, which we have ever encountered. It is represented in three forms, two only of which we will notice, as the third resembles one of the others.

A wheel has spokes projecting out, something like those of a common reel; at the end of each spoke is a roller, turning on gudgeons, parallel to that of the wheel; the under part of the wheel revolves through a trough, or bed piece, which is a segment of a circle, the rollers on the spokes pressing upon whatever may be placed on the

bed of this trough. The rollers or cylinders are to be either smooth or fluted, or covered with cogs,—beaters,—or cleets,—or to have pins projecting from them.

In the other machine a succession of such rollers are fixed horizontally on a frame, and rest upon a revolving endless apron; the revolving endless apron is to be kept in motion by means of a rag wheel, and feed hand; the frame containing the rollers having an alternating motion; the feed hand is attached to this frame.

After the title, which tells us what this machine is to do, we hear no more of most of the articles which it is intended to make, or separate; we are told that "the claim is the construction and operation of this machine. The thickness or thinness of the cloth is effected by regulating the size of the rag wheel."

We do not suppose that any one will be able to tell from our description how cloth, carpeting, hat bodies, &c. &c. &c. &c. are to be made with this machine, as, with the drawing and whole description before us, we are in the same predicament.

It ought to be mentioned that in the horizontal machine, besides the rollers which, we suppose, are intended to felt the wool, there are two others, one of which is "to be fed with colouring so as to colour the cloth," and passed from thence "to another cylinder, which may be carved in figures so as to stamp it."

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31. For *Guide and Sign Boards;* Stanley Carter, Raynham, Bristol county, Massachusetts, November 25.

"The board is branded with letters, figures, and such ornaments as may be desired, by means of metal stamps cast in the form of such letters, figures, or ornaments; which stamps are heated to a red heat, and applied to the board, when it is dry, thereby making a deep impression on the board." The claim is to said improvement.

We must doubt the validity of such a patent, as it is merely applying to sign boards, &c. what has been known and used upon barrels, &c. time out of mind. May a blacksmith hereafter burn his name upon his door, as we have frequently seen it done in country shops?

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32. For an improved *Door Spring;* Lynus Burwell, Berlin, Connecticut, November 25.

A spring, ten or twelve inches long, is let into the back, or hinge stile, of the door, a long mortise being made in it for that purpose. The spring is fixed firmly at its lower end; its upper end is bent so as to form a hook, which is connected, by a short rod, to a staple in the rebate of the frame. When the door is closed the spring retires towards the bottom of the mortise; when open, it approached the edge of the stile, and acts upon the door.

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33. For a *Thrashing Machine;* Thomas G. Owen, Baltimore, Maryland, November 26.

In this machine the grain is to be thrashed by eight or more vertical beaters placed side by side, and lifted alternately by cams, in the manner of stampers. The grain is to be placed upon an inclined floor, behind the beaters, and is drawn forward by being pressed between two fluted rollers, placed one over the other. These feed rollers are turned by a vertical shaft, having a right and left handed screw cut upon it, which gear into toothed wheels on the gudgeons of the fluted rollers, and turn them in opposite directions.

The claim is, "1st. The manner of revolving, feeding or pressure rollers, by means of spiral wheels fixed on their respective journals, and driven by right and left hand screws, or threads, cut around, and forming parts of a perpendicular revolving shaft. 2nd. The manner of thrashing grain, or seed, of any kind, by means of pieces of wood, or metal, lifted up and let fall perpendicularly thereon, the said pieces, or beaters, being raised by cams, or fly wheels, having stud rollers attached to a horizontal axis, revolved by crank or other means, and driven by manual or other power."

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34. For *Making Fence of Wire*, or cords, or twine, and in making seines or nets of wire; Chauncey Hall, Meriden, New Haven county, Connecticut, November 27.

In the specification of this patent, there is no claim, and so best, as there is no *novelty* in the *invention*. Fences of wire were common in England many years ago; they were also used in this country, particularly in the neighbourhood of Philadelphia, fifteen or eighteen years since. Messrs. White and Hazard, who at that time had a wire factory at the falls of Schuylkill, not only erected many wire fences, but also formed a wire bridge over the river, in the neighbourhood of their establishment.

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35. For an improvement in the *Buckets of Pumps;* David Coon, Mendon, Monroe county, New York, November 28.

"The improvement consists in having attached to the shaft, a bucket, in the ordinary way, which may be either round or square; the sides of the bucket rise above the valve, and against these, and attached to the shaft are springs, constantly pushing outwards. By means of these the bucket is never liable to get out of order, though the tube may alternately swell and contract. These springs act directly on blocks, to which are attached pieces of leather."

The foregoing is the whole of the specification, and we hardly think that there is enough of novelty in the affair to sustain a claim to an exclusive right. We have frequently leathered the buckets of pumps with the leather extending above the valve, depending sometimes upon a spiral spring within the leather, and at others upon the pressure of the column of water to press the leather against the sides of the pump barrel, the body of the piston fitting loosely; and, at the period when we had opportunities of essaying many plans for pistons and valves, Mr. Jacob Perkins constructed a piston which

operated both as a bucket and a valve, and which acted perfectly well; as it descended, the leather of the piston collapsed and allowed the water to rise above it, and as it ascended it was pressed out by a spring, so as to occupy the area of the cylinder.

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36. For a *Churn;* Hosea H. Grover, Auburn, Cayuga county, New York, November 30.

Eleven pages are occupied with the description of this important instrument, and ends with the following brief claim, "the application of the tapering tub, in connexion with the other apparatus, to churn, or mash."

A frame is made to support a vertical crown wheel, which mashes into a pinion on the shaft which carries the dashers; various modes of forming these are described, and either of them, we have no doubt, will produce good butter from good cream.

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37. For an improved *Paddle for Propelling Steam and other Vessels;* Jacob Perkins, Civil Engineer, a citizen of the United States, but now of London, in England, November 30.

We have already published some observations upon Mr. Perkins' paddle wheel, and will, in an early number, give the specification with engravings.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the power required to propel Carriages on Rail-roads, compared with that for moving boats in Canals. *By* JAMES P. ESPY.

THERE is not, I believe, any subject connected with the arts which presents higher claims to public attention than that of rail-roads; a subject which has been recently treated in an able and perspicuous manner, in a work which deserves to be most particularly recommended to the notice of practical men; the "Rail-road Manual, or a brief exposition of principles and deductions, applicable in tracing the route of a rail-road. By S. H. Long, Baltimore, Lieut. Col. Engineers, in the service of the Baltimore and Ohio Rail-road Company." In two neat little volumes, published in Baltimore, in September last. The talents, the practical acquirements, and the zeal of Col. Long in the public service, are too well known to need any eulogium from me. Every one desirous of information respecting rail-roads, should consult this work; there is one point respecting these structures, which ought to be pressed again and again on the attention of the public, until they are fully aware of the immense advantages rail-roads offer over every other mode of conveyance.

It is known to men of science, that it has been proved, by the most unexceptionable experiments, that the friction of a carriage on a well constructed rail-road, is not increased with an increased velocity; or, in other words, that the tension of a rope with which a

carriage on a rail-road is drawn at one time, with a uniform velocity of 20 feet per second, at another with a uniform velocity of 40 or 100 feet per second, is the same; whilst the tension of a rope drawing a canal boat is 4 times as great with a double velocity, 9 times as great with a triple velocity, and 100 times as great for 10 times the velocity, and, indeed, a little greater, as is clearly shown by some very late and beautiful experiments by Mr. Walker, detailed in the last volume of the Transactions of the Royal Philosophical Society; that is, the resistance increases in a higher ratio than that of the square of the velocity.

Now it has been shown by Mr. Wood, (in his work on canals and rail-roads,) that the resistances on canals and rail-roads are equal, with a velocity of $3\frac{1}{2}$ miles an hour; amounting to about one pound of resistance for every 200 pounds of load: and, according to this ratio, he has calculated, that with a velocity of 6 miles an hour, 3 times as many horses would be required to do the same quantity of work on a canal, which would be required on a rail-road. But, when the new rail-road carriage, invented by Winans, shall be introduced, the resistance may be fairly calculated not to exceed one pound to a thousand, or one-fifth of the quantity allowed by Mr. Wood. According to this ratio, the resistance on a canal would be equal to that on a rail-road, with a velocity on the former of $1\frac{6}{10}$ mile per hour; a double velocity, or $3\frac{1}{5}$ miles per hour, will give four times the resistance on the canal; ten times the velocity, or 16 miles, will give 100 times the resistance; and 20 times the velocity, or 32 miles, (the greatest velocity which locomotive engines have been made to move in Great Britain, would give the enormous resistance of 400 times, in favour of rail-roads. And this is calculated on the supposition that the resistance on canals increases only in proportion to the squares of the velocities, when, in fact, (especially if the canal is narrow and shallow,) it increases in a higher ratio, whilst that on rail-roads is the same at all velocities.

For example, suppose the power to be estimated by the quantity of coals consumed in transporting a given weight with the various velocities mentioned above, it will be found, if the velocity is one mile and six-tenths per hour, the quantity will be the same on the canal as on the rail-road; whereas, if the velocities are 16 miles an hour, the quantity consumed on the canal will be 100 times greater for every mile and one-sixth, while that on the rail-road will remain exactly the same. Now when it is recollected that a very great velocity cannot be obtained at all on canals, and that a velocity of 20, or even 30 miles per hour, can be obtained on a rail-road, with no greater expenditure of coals per mile than would be required on a canal with a velocity of $1\frac{6}{10}$ miles per hour, we may predict, with the greatest confidence, that canals, in a few years, will be entirely supplanted by rail-roads.

This subject should be well studied by public functionaries, lest, at the very moment when canals are about to become obsolete, they ignorantly spend the public money on what, in a few years, will be of no use.

Philadelphia, February 1, 1830.

On Improvements in Effacing in Lithography.

From *Bulletin de la Society d'Encouragement*, Nov. 1828.

The power of *effacing* any part of a design, and of *retouching* it again at pleasure, was one of the most desirable ameliorations in lithography. Two different and opposite means have now conduced to this happy result. The first, and which would naturally present itself to any person conversant with chemistry, consists in the employment of an *alkali*, to dissolve the fatty and viscous materials, by means of which the printing ink attached itself. It is in this manner that MM. *Chevalier* and *Langlume* have resolved the problem, and their success is a new proof of the advantages which result from combining theory with practice. These gentlemen have already published their discovery, in a complete work of their composition; and which has not a little contributed to the progress of lithography.

The other process was contrived, by uniting two different methods; and was also the result of practical observation: namely, the employment which is daily made of an acid, more or less strong, to remove the spots which form themselves upon the margins of the lithographic stones, in printing from them, gave rise to the supposition, that a *vegetable acid*, which should exert but little action upon the stone, would yet suffice for completely effacing all the fatty parts, and thus permit us to make all manner of changes on the places thus perfectly cleansed. This conjecture has been confirmed by the fullest success. The following is the manner of executing this mode of effacing:

We commence, then, by first removing, with *essence of turpentine*, the ink, or the traces of the crayon, from the part where we would change the subject; we then apply, with a hair-pencil, a little *vinegar*. The acid is then removed with a sponge moistened with water; and when the place has become dry, it may be retouched with the same facility as upon a new stone. This process, by means of the vinegar, is a rather quicker and more convenient one for the removal of *writing* from the stone. But in other cases, the employment of *alkali* is more advantageous; it is, in fact, only experience which can determine in which case either of the methods should be used; and, indeed, there are some cases in which either method may be indifferently employed. [*Technological Repository.*

LIST OF ENGLISH PATENTS

Which have passed the Great Seal, from March 26, *to June* 19, 1829.

To William Church, Esq., for certain improvements in buttons, and in the machinery or apparatus for manufacturing the same—March 26.

To William Madely, Farmer, for an apparatus or machine for catching, detecting, and detaining, depredators and trespassers, or

any animal; and which he denominates the Humane Snare—March 28.

To Josias Lambert, Esq., for an improvement in the process of making iron, applicable to the smelting of the ore, and in various subsequent stages of the process, up to the completion of the rods or bars, and also for the improvement of the quality of inferior iron —March 30.

To William Prior, Gentleman, for certain improvements in the construction and combination of machinery for securing, supporting, and striking, the top-masts and top-gallant-masts of ships, and other vessels—April 11.

To John Lihon, a Commander in our Royal Navy, for an improved method of constructing ships' pintles, for hanging the rudder—April 14.

To Benjamin Cook, Brass Founder, for an improved method of making rollers or cylinders of copper, and other metals, or a mixture of metals, for printing of calicoes, silks, cloths, and other articles—April 23.

To James Wright, Soap-maker, for improvements in condensing the gas or gases produced by the decomposition of muriate of soda, and certain other substances, which improvements may also be applied to other purposes—April 28.

To Peter Pickering and William Pickering, Merchants, for an engine or machinery, to be worked by means of fluids, gases, or air, on shore or at sea, and which they mean to denominate Pickerings' Engine—April 28.

To John Davis, Sugar Refiner, who, in consequence of a communication made to him by a foreigner residing abroad, is in possession of a certain improvement in the condenser, used with the said petitioner's apparatus, for boiling sugar in vacuo, for which a patent was granted to him the 29th day of March, 1828, entitled an improvement in boiling or evaporating solutions of sugar and other liquids—April 28.

To Henry Robinson Palmer, Civil Engineer, for a certain improvement or improvements in the construction of warehouses, sheds, and other buildings intended for the protection of property—April 28.

To George William Lee, Merchant, who, in consequence of a communication made to him, by a certain foreigner residing abroad, is in possession of certain improvements in machinery, for spinning cotton and other fibrous substances—May 2.

To Henry Bock, Esq., who, in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of improvements on machinery and apparatus for embroidering or ornamenting cloths, stuffs, and other fabrics—May 2.

To James Dutton, jun. Clothier, for certain improvements for propelling ships, boats, and other vessels, or floating bodies, by steam or other power—May 19.

To Maxwell Dick, Bookseller and Publisher, for an improved railroad, and method of propelling carriages thereon by machinery, for

the purpose of conveying passengers, letters, intelligence, packets, and other goods, with great velocity—May 21.

To Thomas Robinson Williams, Esq., for improvements in the making or manufacturing of felt, or a substance of the nature thereof, applicable to the covering of the bottoms of vessels, and other purposes—May 23.

To Thomas Arnold, Tin-plate Worker, for a new or improved machine or gauge, for the purpose of denoting the quality of fluids, or spirituous liquors, and for measuring or denoting the quantity of fluids or spirituous liquors withdrawn from the vessels or receptacles in which the same are contained, and which machine or gauge may be so constructed, as to affect either of the above objects, without the other, if required—May 26.

To William Poole, Smith, for certain improvements in machinery for propelling vessels, and giving motion to mills, and other machinery—May 26.

To Charles Turner Sturtivant, Soap-boiler, for certain improvements in the process of manufacturing soap—May 26.

To Joseph Cliseld Daniel, Clothier, for certain improvements in machinery, applicable to dressing woollen cloth—May 26.

To Ross Winans, for certain improvements in diminishing friction in wheel carriages, to be used on rail and other roads, and which improvements are also applicable to other purposes—May 28.

To William Mann, Gentleman, for his discovery, that by the application of compressed air, power and motion can be communicated to fixed machinery, and to carriages and other locomotive machines; and also to ships, vessels, and other floating bodies—June 1.

To Andrew Gottlieb, Locksmith, for certain improvements on, or additions to, locks and keys—June 1.

To John Smith, Corn-miller, being one of the people called quakers, for certain improvements in machinery for dressing flour—June 1.

To Charles Brook, Cotton Spinner, for certain improvements in machinery for spinning cotton, and other fibrous substances—June 4.

To Robert Porter, Iron manufacturer, for a certain improvement or improvements in iron heels and tips for boots and shoes—June 13.

To Francis Day, Optician, and August Münch, Mechanic, who, in consequence of a communication made to them by a certain foreigner residing abroad, and inventions by themselves, are in possession of certain improvements on musical instruments—June 16.

To Charles Wheatstone, Musical Instrument-maker, for a certain improvement or improvements in the construction of wind musical instruments—June 19.

To Moses Poole, Gentleman, who in consequence of a communication made to him by a certain foreigner residing abroad, is in possession of certain improved machinery for kneading dough—June 19.